THE

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THE

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PARALLEL RUNNING OF ALTERNATORS.

THERE is always an amount of trouble and uncertainty in synchronising alternators for parallel running. If a machine is thrown into parallel with others already running, there will be considerable strain on the engines, and abnormally heavy currents will flow through the alternators, unless the speed of the incoming machine is almost exactly the same as those already running. The result is that unless the operation of paralleling is skilfully performed, there is a flickering of the lights, as well as a risk of opening the circuit breakers. The usual method of synchronising by means of a phasing lamp is but an indifferent way of overcoming the difficulty, if the difficulty can be said to be overcome by such means. The phasing lamp indicates roughly the difference between the speeds of two machines, but gives no indication whatever as to which machine has the greater speed. An arrangement by which the relative speeds of two alternators could be accurately indicated would be very valuable in alternating stations, where the operation of paralleling is of frequent occurrence.

In a recent number of the *Electrical World* (N.Y.), Mr. Burch suggests the following method of paralleling. Suppose several large alternators are to be started at the same time. Proceed as follows:—Start them, get them at approximately the same speed, and connect the unexcited alternators in parallel by means of the usual switches. After this, close the field switches of the alternators, and then excite all the alternators simultaneously by closing the exciter switch. The alternators will buck for a minute, and then settle down.

If it is required to switch on an additional machine in parallel with others already running, the method is somewhat similar. Get the additional machine up to speed, and then throw in the paralleling switch without exciting the machine. Its armature instantly takes a lagging current, which acts like a transformer on open secondary. The field may then be excited without any delay, and the lagging current is eliminated. There is a mechanical strain on the armature coils, but they are usually wound so solidly that there is no attendant risk.

In another column of the same issue of the *Electrical World* it is pointed out that on throwing an unexcited alternator in parallel with others already running another danger may be involved. The lagging current taken by the armature of the incoming machine would itself produce an excitation of the alternator field. It is stated that the excitation is as liable to be in a direction the reverse of that given by the exciting winding as in the same direction, and in the former case would take, as long as the machine continued running, heavy lagging currents to maintain the reverse magnetisation.

To us it would appear that this lagging current is necessarily producing a field in the alternator in opposition to that to be produced by the exciting current. By hypothesis,

the incoming machine is to be run in phase with the machines already running, and the lagging current caused by switching on the unexcited alternator tends to demagnetise their fields, and will consequently oppose the field of the incoming alternator as soon as it is excited. This will involve an instantaneous heavy rush of current through the armature, but there is no apparent reason why the lagging current should remain after the operation is completed.

The Faraday and Zeeman Effects.

Prof. Fitzgerald contributes to *Science Progress* an interesting article on the connection between the action of magnetism on light discovered a good many years ago by Faraday, and the recent discovery by Zeeman that the lines of the spectrum are visibly affected by the magnetic field. Faraday showed that when a beam of polarised light was sent along the lines of force through a transparent substance in a strong magnetic field, the plane of polarisation was turned through a small angle. Several hypotheses have been advanced to explain this phenomenon, but it was impossible to say which was correct till Zeeman's experiments supplied the required *vera causa* which has established the validity of one of these hypotheses. The Faraday effect may be explained by supposing that the rotating molecules of the substance in the magnetic field have their frequency slightly increased or diminished by the action of the magnetic field. Theoretically a beam of polarised light can be looked upon as composed of two beams of light circularly polarised in opposite directions. The frequency of one of these beams will be slightly increased, while the frequency of the other will be diminished, by the different speeds of rotation of the molecules by which they are affected, and the result will be the rotation of the plane of polarisation which Faraday first observed. Now, Zeeman's experiments have shown that the magnetic field has the effect of altering the speed of rotation in the manner described, in the molecules of a gas at least; and the probability is that the same is true of solids. The phenomena are not quite so simple as in the case we have taken as an illustration, but there cannot be much doubt that the Faraday and Zeeman effects are connected in the manner indicated. Zeeman's discovery, when brought into relation with what was previously known, enables us to pick out the true from the false hypotheses, and thereby considerably increases our knowledge of molecular physics. The deviations from the theoretically predicted results may be of the greatest value in showing how our fundamental assumptions will yet have to be modified.

Improvements in Lead Accumulators.

An accumulator is, in theory, a reversible voltaic cell, which shall store without loss, electrical energy supplied to it, and give that energy out again without loss, when required. Many cells, Daniell's for example, are theoretically accumulators, but are not reversible in practice for mechanical or physical reasons, and the only cell to be considered in practice is the lead accumulator. This, too, is only capable of restoring about 80 per cent. of the energy supplied to it—a defect inherent in its nature, and arising from the fact that the chemical re-actions during charging are not exactly the reverse of those during discharge. But the lead accumulator will give out practically the whole of the energy which it actually takes in from the charging current; hence improvements are to be looked for, not in the direction of increased efficiency, but, on the one hand, in the increase of the capability of the cell to retain its charge for a long while without diminution, and on the other, in the increase of its capacity, and of its power to retain that capacity unimpaired under widely varying conditions of charge and discharge. By the use of pure acid and the avoidance of great differences of concentration in different layers, together with care in manipulation, so as to avoid short-circuiting in the cell, very satisfactory results have been attained as far as the retention of charge is concerned; though in cells consisting of a paste of red lead supported by a framework of lead, the continual changes of volume during the conversion of that into lead-sponge or peroxide, &c., tend to disintegrate the plates and form a source of danger from short-circuiting. Many of the various devices (specially shaped framework, porous covers or cases for the plates, canals to facilitate the escape of gas) invented to overcome this difficulty are very successful. With insufficiently porous material, the inner portions are never reached, which not only means diminished capacity, but a diminution of the available current that can be used, both in charge and discharge. It means also an increase of the liability to disintegration if this current be exceeded—a disadvantage especially where accumulators are used for such purposes as street traction. Attempts at improvement in this direction have mostly gone on the lines of increasing the fineness of division of the spongy lead, either chemically or mechanically; the Gelnhausen Electric Company, for example, grind the spongy lead with pumice-stone powder, whilst Pollak forces molten lead into the interstices of a powdered substance, such as common salt, which is afterwards dissolved out of the solidified mass. The addition of manganese dioxide to the active mass, is not, on the whole, to be recommended, as slow discharge is apt to take place in an open circuit. Experience has shown that the addition of the various organic substances which have been suggested from time to time does not prolong the life of the cell, though the complete oxidation and disappearance of such organic substances should leave the lead in a state of favourable porosity. For securing good contact between the support and the active mass in the positive plate, no plan is so good as "formation" by the old Planté process; the time needed for this, however, is prohibitory. The Hagen manufactory carry this process on for about 10 weeks, and then cover the partially "formed" plates with the ordinary paste; whilst, according to Lucknow, a few days suffice to produce a "formed" plate, if the electrolysis of a very dilute, neutral, or faintly acid or alkaline solution of salt of the alkali or alkaline earth metals be carried on by a moderately strong current in one direction, between lead plates. The lessening of the weight of an accumulator of given capacity is also a problem to be worked at. Gülcher has made an important advance in this direction. He makes his plates of a sort of fabric, the warp being of lead wire and the weft of glass wool. The finely-divided active mass adheres firmly to this, and the finished plates are cased in glass wool, which insulates them and lessens the risk of disintegration from mechanical causes, without impeding too much the circulation of the liquid. This accumulator has not more than one-third to one-half the weight of an ordinary cell of equal capacity. The above is an abstract of a paper by F. Foerster in the *Chemiker Industrie*, xxi. (3), 47—51.

A Sequel to the Engineers' Strike.—In consequence of the great pressure of work in all the locomotive engineers' shops throughout the country—due to the arrears left by the engineers' strike—and the utter impossibility of obtaining deliveries within a reasonable period, the Midland Railway Company have been compelled to place an order for 20 goods engines and tenders, which are urgently needed, with Philadelphia and New York firms. At the present time the Midland have 200 engines on order with English firms.

A DIRECT READING OHMMETER.

A new device for measuring resistance has been placed on the market, and is depicted in the accompanying cut taken from the *American Electrician*. It is, strictly speaking, a commercialised slide wire bridge. A wire is stretched over a scale, which is divided into two parts, making the entire scale some 30 inches long. The resistance to be measured is to be connected across the two further binding posts. A telephone is used as the detector, and a hard rubber stylus, provided with a battery key, is held in the hand, and is touched at various points along the slide wire, until a point is reached where no sound is heard in the receiver, when the resistance in ohms may be read off directly from the scale beneath.

The scale is lettered in three colours, and there are three plug holes in one end of the bridge coloured to correspond, and it is obvious that when the plug is placed in a hole, the scale of the corresponding colour responds. The resistance is connected directly across two of the binding posts, the third being provided so that other cells can be used in case the cells in the box should become exhausted, and it be not convenient to renew them at once. The claims the manufacturers make for this instrument are its rapidity of operation, simplicity, adaptability to be used in any position, and in dynamo rooms where strong magnetic fields are prevalent, and its cheapness. Notwithstanding the low figure at which it is sold, it is thoroughly well made, being finished in polished mahogany, with polished hard rubber trimmings, and accurately finished lacquered brass connecting blocks. It carries its own battery, is complete in itself, and is always ready for use, and is as easily applied to a circuit as a voltmeter. It is particularly useful in running down faults on telephone switchboards, dynamos, field coils, and all constructions which use electro-magnets or resistances of any kind. It has just been placed upon the market by the American Electric Specialty Company of New York City.

A Direct Reading Ohmmeter.

ELECTRICAL CANAL TRACTION.

III.

In July, 1895, M. Denèfle was authorised to instal an electrical system on the Canal Bourgogne, between Dijon and Lock 57, about 4 kilometres. Water is again the motive power, a fall of 2·60 m. of 40,000 m³ daily being available. The line is placed 5 m. above the tow-path, supported on posts at 50 m. span, and two chariots transmit current to the electric horse or to the towing machine as already described. Messrs. Maillet and Dufourmy, Belgian engineers, have thus spoken of the installation of which they made a test. The electrical horse alone operated a string of boats of a total of 566 tons, and one of four boats of 739 tons, at a speed of 1,900 m. per hour. It ran well without any transverse deviation from the pull of the tow-rope or any damage to the tow-path. The tow-boat, also operating with a screw propeller, and of a length of 33·38 m., and a width of 5·02 m., with a load of 217 tons, travelled at a speed of 2,410 to 3,150 m. per hour on March 9th, and with a load of 175 tons an equal size of boat ran 2,400 to 3,000 m. per hour with the same machinery. M. Denèfle has also installed his system on the canal of the Aire and Deule between Marles and Pont à Vendin with the ultimate idea of extension over the whole length of 48 kilom. between Béthune and Ecaut. In 1895 there passed over this canal 3,118,000 tons, the equivalent of 11,000 full boats and 5,274 empty ones, which represents daily, allowing for holidays, 34 full boats and 16 empty ones. The power necessary to haul these 50 boats is about 110 kw. or 206 H.P., but 300 H.P. may be allowed for a good margin. The country being flat water-power was not to be had, and the company put in two steam plants, one at Beuvy, one at Bauvin, each containing four engines of 50 H.P. with a working pressure of 5·5 k. per cm² and each driving its own dynamo. Semi-tubular boilers of 135 m² heating surface produce 3,250 k. of steam per hour. Ordinarily three engines are at work with one in reserve.

The dynamos are guaranteed an efficiency of 91 per cent., the motors of 87 per cent. At each station the three running groups yield 144 amperes of current or a total of 288 amperes at 625 volts at the terminals. At the most distant part of the line the current is at 500 volts. The conductor is 7 mm. in diameter, of chrome bronze, 98 per cent. conductivity. There are two or three of these according to the section of the line. They are carried 6 metres high on Finland pine posts spaced 40 m. The return wires are carried by iron brackets, and are earthed every two posts. The cost was 700,000 francs (£28,000), and its working should yield 155,500 francs (£6,220).

The figures show that if the price of haulage is the same as that on the Grand Canal, Paris, to the sea, there should be a yearly tonnage of 2,300,000 to cover the costs. This is really exceeded. The comparison of various systems must be made from the double point of view of working and economy.

The system of M. Levy by travelling rope is said to be very perfect, and to demand no variation of existing boats in any point, but it has the inconvenience of a moving rope many kilometres in length put into motion by a single machine, and liable to break down without any power of the engineer to anticipate or prevent. The rope must always be moving whatever the fewness of boats, and there can be no variation of speed. A cable only lasts four or five years, the life of the pulleys is still less, and they require rebushing every two or three months. Then the gripping of the tow-rope is inconvenient and needs a man ashore to follow and prevent accident by twisting of the cable and the tow-ropes together. It is difficult to stop a cable from rotating on its own axis. The same thing is found to occur in main driving ropes, though beyond causing extra wear and tear there is nothing harmful in such rotation; but in boat haulage the revolution of the cable carries round the tow-rope, and this is a serious difficulty. Square ropes have been tried by some rope makers as a remedy. They are made from 4—8 strands twisted in opposite directions, one half each way, so that the cable is neutral. Such cables are less extensible than circular cables, more flexible, and less absorptive of force at changes of direction. Their radius of inertia is less, and they do not twist, but always keep the same side to the top. It is proposed to test such a rope on a length of 30 kiloms. between Riesenbeck and Sleesen, on a German canal from Dortmund to Ems.

The electrical horse is well spoken of in the paper. It is strong and simple in construction, and works either way without shock on an instant's call. The only fear is as to any damage to the tow-path, and room under the bridges. It is not cumbrous or difficult to control, but it requires a

man to control, but it calls for no change in the existing *régime*, being merely a machine horse. A convoy of boats is just as possible with it as with a tug-boat. In energy consumed per boat the following figures are given:—

Per boat of	387	tons at	2 kilomes. per hour,	3·45 kw.
„	186	„	3 „ „	1·8 „
Unloaded at			6 „ „	0·9 „

The Lamb system already referred to as consisting of electric motors running on cables has not been applied on a large scale. It is objected to this system that two motors cannot pass, but that the up and down haulage must be done from different banks. But we do not see that this need be necessary; for why should not the up and down carrier cables be placed at different heights on the same post, the machine on the higher cable hauling the far side boat? This, or its equivalent, is done on the Thwaite-Cawley system, in which the track is of rigid section rolled iron.

It is urged against screw propellers that, especially in canals of small cross section, the waves are a very powerful cause of disintegration of the banks, the water movement produced in conjunction with the boat displacement action, is a peculiar helicoidal motion, much more destructive than at first sight appears. There are difficulties with screw propulsion, also, in the stern currents set up against a towed boat whose resistance is much increased, but it has the advantage of leaving the bank free, and it avoids the crossing difficulty. The stern of a blunt boat is also not a very suitable place for the working of a screw, for water cannot flow freely to it. It appears that if to propel a boat a mean expenditure of 4 kw. is required, then the electric haulage only demands 2·2 kw.

The chain system has a difficulty that when single the passing of boats and changing off and on the chain by one of them is difficult and may be dangerous, whilst where there are two chains there is apt to be trouble at curves with the chains becoming entangled. Boats govern well, motion is regular and lively, and generally the system performs all that it is possible to hope for. We cannot call to mind a single instance at the moment of a chain ferry in this country or of a chain system on any canal, but have seen the system employed in Holland for a ferry-boat across the Y.

Accumulator haulage is only looked upon as having a limited field. Its advantage is that each boat is independent and carries its own motive power. Overhead conductors give great flexibility to the traffic. In towns with a canal network, accumulators, alone are looked on as practicable—the trolley wire would be too complicated, besides being in the way of animal traction, masts, and steamboat funnels, and quite hopeless at a seaport where boats must be free to go alongside any wharf or ship at will. The question of general resistance is too complicated to deal with; the resistance of the waterway is no negligible quantity, yet it is very variable with the size of boat, but it may be said that the surface condition of the hull is one of great influence.

For the same boat at different draughts the traction increases less quickly than the submerged midship section, and more quickly than the total wetted surface.

For boats of equal midship section, having forms as near alike as possible, but of different length, the total resistance is sensibly alike and independent of length. A convoy of boats gives a total resistance sensibly equal to the sum of the resistances of the boats making up the convoy. Nevertheless diminution of resistance may be obtained, varying with the speed, if the towed vessels are so coupled as to establish a solidarity as complete as is possible between the different elements of the same convoy. This, of course, is on a par with close coupling of railway cars, whereby considerable reduction of resistance is obtained.

The resistance of the waterway for two canals of the same form, the resistance is less in the larger waterway. Resistance depends on the state of the surface, being less in a canal well protected by stone, than in one where the banks are protected by reeds and rushes. A rectangular profile offers a marked superiority to one of trapezoidal form.

A final word for the horse. M. Derôme, the chief engineer of navigable ways of the north of France, shows that the horse has successfully triumphed over all means of mechanical propulsion, working at an astonishingly cheap rate, and bringing down prices as low as 2 millimes per ton-kilometre.

The system has the overpowering advantage of the first order in that general expenses are almost *nil*. The whole expense of haulage is made up of two factors, a constant term whatever the number of boats in a train, and a term proportionate to the number hauled. The small value of the first term shows little chance of diminishing the cost of a ton-kilometre by mechanical means. But the increase of speed by which a canal is covered more rapidly, constitutes an economy for the boating industry. In chain haulage the initial cost is high. On the Oder and Spree it is given as 34,414 francs per kilom. (£1,377); on that of St. Maur and St. Maurice 28,846 francs. The annual cost for a day's work of 12 hours is 4,600 francs per kilom., including interest and depreciation. The cost of traction is thus about ·002 franc per ton. In the Mont-de-Billy tunnel the first cost was 50,000 francs per kilom. (£2,000), and the working cost 5,775 francs the ton kilom., costing a little over ·004 franc.

M. Levy has fixed 900,000 tons as the smallest annual tonnage at which chain haulage can compete with horses. Under a tonnage of 2½ millions chain haulage appears to excel all the electrical methods. The electrical horse seems scarcely suitable for small canals and little boats, but offers a chance of reducing costs on large canals, and reducing also the length of journey. Applied to convoys of boats the system is still more advantageous on rivers and currents. The first cost may be set down at 26,000 francs per kilom. The electrical horse itself costs 5,700 francs.

For an annual tonnage of 3,000,000, screw propulsion costs about 25 per cent. more than chain towage, but the contrary is the case for smaller traffic, so that for 200,000 tons towage is 11 per cent. dearer than screw propulsion. Equality between the two systems is reached at about 400 to 500 thousand tons but both systems are passed by haulage. On the canal of Aire and Deule the cost of installation was 27,000 francs per km., and the working expense 6,000 francs per km., so that the cost of transport of 1 ton 1 km. was 0·002 franc. On the summit level of the Canal Bourgogne the installation cost 22,250 francs per km., and the ton-kilometre cost was 0·012 franc, and M. Bovet estimates for a canal of 50 km. and a tonnage of 3,360,000 would cost 1,250,000 francs, or 25,000 francs per km. The Bovet towing apparatus costs 3,000 francs, and the Denèfle propeller 6,300 francs.

THE ELBEUF ELECTRIC TRAMWAYS.

THE ordinary Englishman's conception of the pretty little Norman town of Elbeuf is merely such as he can form upon a railway carriage window acquaintance as he passed through on his way to Paris from Havre or Dieppe; but those whose lot has perhaps taken them there in youth to one or other of the good schools that used to flourish in Normandy 20 years ago, or later on in connection with such businesses as cotton spinning, weaving, and dyeing, will remember that Elbeuf is a very vigorous neighbour of the big city near it, Rouen, only 13 miles away.

The latter place has—as most of our readers will probably be aware—enjoyed the benefits of electric traction for nearly four years now; and the results have been more than sufficient to justify the neighbouring towns in authorising the construction of electric tramways within their areas.

The fact of such developments being entirely in the hands of private interests, and not those of the municipalities, offers too large a field for discussion just now; it may well receive extended notice by itself; at present we need only remark that the tramway company at Rouen has served, and continues to serve, the public requirements so excellently that in response the proportion of passengers to the total number of inhabitants is nearly 300 per cent. *every week!* That is to say, the tramway on the average carries every week passengers to the extent of nearly three times the entire population.

In 1895 the total of passengers carried reached 5,000,000; in 1897 this was increased to 14,000,000, a result probably not surpassed even on the much-vaunted Glasgow tramways.

It is small wonder, therefore, that Elbeuf, although possessing only a quarter, or a fifth, the population of Rouen, should wish for the advantages of electric traction; and now

the good folks of the town can boast of a service equally extensive in proportion.

Rouen has a population of about 120,000 and a network of electric tramways at work totalling up to about 28 or 30 miles. The population of Elbeuf is about 24,000, and the extent of tramways now installed is 6½ miles.

	Population.	Length of tramways.	Passengers carried per annum.
Rouen	120,000	28—30	14,000,000
Elbeuf	24,000	6½	Recently opened

It is instructive to compare these figures with corresponding ones taken haphazard in this country with horse traction :—

Leicester ...	120,000	9	5,000,000
Lancaster ...	21,000	4¼	450,000

The Elbeuf tramways were opened on May 26th last, so we are informed by our contemporary *L'Electricien*, from whose pages most of our description is obtained, and exact traffic results are therefore not available as yet, even for the first six months, though every satisfaction is felt with the amount of patronage given to the cars by the public.

The system practically comprises one long line right through the town, with a shorter cross line from the main railway station, and passing over the River Seine, with a short branch to the quays for goods traffic.

Some interesting features are to be noted in the design and construction work. First of all, the usual double trolley wire line has the two wires cross connected every third of a mile. A special return feeder is taken from the power house to the central point of the system where the two main lines cross, and there joined to the rails. This return feeder is merely composed of four bare copper wires 14 mm. diameter lying in a V-shaped slight wooden trough filled in with bitumen.

The line passing over the Seine river bridge has necessitated several somewhat unusual precautions. The rails themselves are absolutely insulated from the main structure of the bridge by being placed on solid oak beams or longitudinals. Plain H beams or steel joists lie on each side of the oak longitudinals and are riveted to the bridge floor plates. The space in between the steel joists and the wooden beams is filled up with cement concrete, with two layers of bitumen asphalte over all.

A special insulated return feeder is carried across the bridge, connecting the rails on either side with another return feeder having branches to each pair of rails, the points of which are opposite one another.

As the car passes over the bridge, therefore, and over each succeeding pair of rails, the circuit is completed through the respective branches to the secondary feeder, and thence to the main return feeder. The rails on the bridge are otherwise completely insulated, and separated electrically and mechanically from the track on either side.

There is not much comment to pass upon the rolling stock employed. Twelve motor cars and five trailers are used for the ordinary service; each car has seating accommodation for six first-class and 18 second-class passengers; 10 are allowed to stand on each platform, so that a total of 44 passengers may be carried on each car. The Dickinson side swivelling trolley is employed, and the side bracket arms on the street poles are therefore very short, not more than 4 or 5 feet on the average.

There seems an increasing and praiseworthy tendency abroad to diminish as much as possible by such means the admitted want of beauty in overhead wires strung up in the old-fashioned ways, and those engaged in electric traction in this country would do well to pay attention to practice on the Continent, so as to avoid the use of excessively long gallows-like bracket arms, or a birdcage span wire construction, such as might be pointed out in more than one place on this side the Straits of Dover.

King's College, London.—The Sir David Salomons Scholarship for 1899 has been awarded by the Institution of Electrical Engineers to T. R. Renfree, student in the Siemens Engineering Laboratory of King's College.

STORAGE BATTERIES FOR ROAD TRACTION.

At the present moment France appears to be taking the lead in the work of rendering electric traction on common roads more practicable. The main point, of course, is to obtain a much lighter form of battery than those which have given satisfaction as stationary accumulators. Some of these robust and durable appliances have, it is true, been used for road traction in New York and elsewhere; but the experiments, we take it, have been more safe than satisfactory, and from a financial point of view even the element of safety has been rendered problematical by the high ratio of non-effective to effective work due to the great proportionate weight of battery to be transported.

Nothing has been done—nothing is likely to be done—with accumulators other than those in which peroxide of lead and spongy lead are the active materials. In America some attention has been given to the ammonium chloride accumulator, with carbon plates, invented by Senor A. Sandaran; but, whilst it might fairly claim to be a very light form of secondary cell, the evolution of offensive and irritating fumes, consisting of ammonia and chlorine, would have rendered it quite impracticable, even if its low efficiency had not condemned it. It is, in fact, an objectionable modification of the Commelin-Desmazures cell. Nor has anything strikingly novel been adopted or attempted, although we hear of striking novelties obtained, and tested, on a small scale, in electro-chemical laboratories. In regard to novelty, the most noteworthy result is the production, in the new form of the Fulmen accumulator, of peroxide active material of extraordinarily low specific gravity. The ordinary material varies in specific gravity from 6 to 8·17, but a sample of the Fulmen peroxide which we examined had the specific gravity 4·2, and, although soft, possessed considerable coherence. The recent performances of this battery, at the Cab Competition organised by the Automobile Club of France, are no doubt due in great measure to the great porosity of the active material.

The most recent competitor in the field with light traction batteries is the firm of Valls & Cie., of Paris and Lagny (Seine et Marne). These manufacturers put forward three special types of battery for the propulsion of automobile vehicles, viz., a *normal*, a *light*, and a *very* light type. All three are of the pasted kind, and bear a general resemblance to some of the forms which have been manufactured by the E.P.S. Company. "Very light" and "light" open grids contain the active material in the two last types, whilst in the case of the normal type the active material is lodged in sub-divided grooves having a downward slant in the direction of a somewhat substantial solid core of metal, which is perforated with 36 holes, for the purpose of allowing the circulation of the electrolyte. From these types the public are invited to make a choice, after the fashion of Portia's lovers in the "Merchant of Venice," and to discover by experience which is to carry off the prize of success.

The *très léger* type is the only one of particular interest from our present point of view. The design of the cell has no doubt been carefully considered in the light of an extended experience, but as it presents no novelty, we can afford space only for the condensed data in relation to it. With the normal period of discharge of five and a half hours we have for the specific rate of discharge—taking gross weight of battery :—

$$\frac{\text{Amperes}}{\text{lb.}} = 0{\cdot}868.$$

This normal rate of discharge may, for short periods of time, be increased twofold. For a battery satisfactory in other respects, this rate is fairly satisfactory also, without being in any way remarkable. The ratio of watts to lb. gross weight is 1·65.

In capacity, the battery is more than fairly good, as will be seen from the ratios :—

$$\frac{\text{Ampere-hours}}{\text{per lb. gross wt. of batt.}} = 4{\cdot}83, \text{ and } \frac{\text{Watt-hours}}{\text{lb.}} = 9\ 37.$$

Forty-four cells of this battery, weighing 6·9 cwt., will—presumably on a hard level road—convey a load of 25½ cwt. (including weight of cells) over a distance of 37½ miles, at

the speed of $7\frac{1}{3}$ miles per hour. The ratio of total traction weight to weight of battery was $\frac{W}{A} = 3{\cdot}69$

For this type of battery, the normal density of current—an important consideration—is :—

$$\Delta = \frac{15{\cdot}6 \text{ amp.}}{381 \text{ sq. in.}} = 041.$$

It will be interesting to compare with these data those arrived at in relation to the new form of Fulmen battery by the jury appointed to consider the results obtained in the recent *Concours* at Paris.

The normal rate of discharge was :—

$$\frac{\text{Amperes}}{\text{per lb. gross wt. of batt.}} = 1{\cdot}23$$

The specific power was :—

$$\frac{\text{Watts}}{\text{lb.}} = 2{\cdot}32$$

The specific capacity was :—

$$\frac{\text{Ampere-hours}}{\text{lb.}} = 6$$

The specific energy was :—

$$\frac{\text{Watt-hours}}{\text{lb.}} = 11{\cdot}36$$

The weight of battery per H.P.-hour was 65 lbs., and the normal density of current was $\Delta = \frac{21{\cdot}6 \text{ amp.}}{335 \text{ sq. in.}} = {\cdot}064.$

In the various trials the ratio $\left(\frac{W}{A}\right)$ of total traction weight to weight of battery varied from 2·68 to 3·89.

It is impossible to make a fair comparison of traction results unless they have been obtained over the same ground, and—if not at the same time—when the condition of the road is the same. This applies especially to the comparison of the performances of different accumulators. But supposing the conditions of traction to be the same, accumulators may, by a scientific use of the imagination, conveniently be compared by comparing the respective distances over which *any weight* of the given batteries would transport itself only. By this method, which is due to Mr. Desmond FitzGerald, the comparative traction values of batteries are expressed by distances. Thus, if l be the distance over which a given weight (A) of a battery will convey at a given speed a given traction load (W) including A; then, L being the distance through which the battery would transport its own weight only, we have the proportion :—

$$A : l :: W : L$$

whence $$L = l \frac{W}{A}.$$

According to this formula, any weight of the accumulator which has been worked by the London Electric Cab Company would convey itself over the distance :—

$$L = 50 \text{ miles} \times \frac{30 \text{ cwt.}}{14 \text{ cwt.}} = 107 \text{ miles.}$$

An ounce or a ton of the *très léger* accumulator of Valls & Cie. would, presumably, as we have said, on a hard level road, carry itself over a distance of

$$L = 37{\cdot}5 \times \frac{2\,860 \text{ lbs.}}{774 \text{ lbs.}} = 139 \text{ miles.}$$

And, under the various conditions which prevailed during the Paris *Concours*, the Fulmen batteries (or any portion of them) which were used in the three Kriéger carriages and in the Jenatzy and Jeantaud vehicles would respectively have carried themselves over the distances of 204, 209, 248, 222, and 147 miles.

What we consider to be a serious defect in the French accumulators referred to is that they both—and more particularly the Fulmen—have metallic lead in direct contact with the electrolyte. In other words, the metallic supports are not embedded in and protected by the active material. From this defect must result not only a loss of current in charging, but a comparatively rapid corrosion of the support. What is required, and what we believe will be forthcoming is an active material which will not disintegrate, and in which, therefore, the support may safely be embedded.

SOME NOTES ON THE RECOVERY AND REFINING OF NICKEL.

By SHERARD COWPER-COLES.

Every year nickel is taking a more prominent position in the industrial world, and electrical methods are being applied both to the winning, refining, and electro-deposition of nickel on a large scale. Nickel holding a position in the metallurgical world between copper and iron, can be won by methods analogous with those employed for both metals. It combines readily with the metalloids, with sulphur and arsenic, which play a prominent part in the metallurgy of this metal. All the important nickel compounds met with industrially are derived from the protoxide NiO, the peroxide being a very unstable salt. The sulphide ore can be run into a matte or regulus, and the oxides directly reduced to crude metal, also the arsenside (speise), which are subjected to either dry or wet treatment, mainly with a view to separate the associated carbon.

The Burton forge is said to have been applied to the treatment of nickel ore in Canada. The oxide is enclosed in a cradle and submitted to the combined action of the arc and of hydrogen, by immersion as the positive electrode in a current of great intensity in a suitable electrolyte. The possibility of depositing nickel electrolytically appears to have been first contemplated in the year 1840 when an English patent was filed covering the use of the double cyanide of nickel and potassium as an electrolyte. This process has been of no service in the electro-metallurgical extraction of nickel. R. Böttger has succeeded in obtaining good deposits from the double sulphates of nickel and ammonia, and this process is the one which is now almost entirely used for the electro-deposition of nickel. Mineral acids, if in the free condition, are found to be detrimental; boric and phosphoric acids, however, appear to be harmless, of basic solutions only those which are ammoniacal can be used. Borcher recommends the use of sulphonic acid as a depolarising agent.

Dr. Ludwig Mond's process is an entirely new department in metallurgical practice, and is based on the simple property possessed by nickel of forming a volatile compound with carbon monoxide, metallic nickel being released when the compound is heated to 180° C. Dr. Ludwig Mond, in collaboration with Dr. Carl Langer, has discovered a method of eliminating the carbon monoxide from gases containing hydrogen. They were guided by the observation that finely divided nickel removed carbon from carbon monoxide, at a temperature of 350° C, converting it into carbon dioxide, whereas the dissociation of carbon monoxide by heat alone, according to Victor Meyer and Carl Langer, remained incomplete at a temperature of 1,690° C. In the original experiments carried on in connection with Dr. Friedrich Quincke finely divided nickel was formed by reducing nickel oxide at 350° C; by hydrogen treated with pure carbon monoxide in a glass tube at varying temperatures. The gas escaping from the apparatus was ignited, and while the tube containing nickel was cooling, the flame became luminous and increased in luminosity as the temperature sank below 100° C. Metallic spots were deposited on a cold plate of porcelain, held in this luminous flame, and on heating the tube through which the gas was escaping a metallic mirror was obtained, while the luminosity of the flame disappeared. These metallic deposits were found to be pure nickel. Nickel carbonyl was then isolated in a liquid state, and it was possible to produce it with facility in any desired quantity. No other metals which were submitted to investigation showed indications of combining with carbon monoxide except iron. The result of these discoveries was that in 1892 an experimental plant on a large scale was erected at Smethwick, near Birmingham.

F. Föerster is amongst the foremost who have applied electro-metallurgical methods to the winning of nickel. He has carried out a number of valuable investigations to determine the cause why nickel deposits are inclined to peel. It does not appear to be due to oxygen; electrolytic cobalt contains oxygen, but the deposition does not offer any great difficulty. The best results were obtained from hot neutral sulphate solutions, but the percentage of iron and cobalt was hardly altered, so for refining purposes this electrolyte is unsuitable. Carbon, silicon, and copper did not contaminate the deposited nickel. Nickel chloride solutions were found

to be troublesome, hot neutral solutions formed basic chlorides; but this difficulty was overcome by adding hydrochloric acid, but then hydrogen was given off at the cathode, which interfered with the deposit.

In André's process, copper or carbon plates are used as cathodes, and nickel matte, speise or impure nickel, cobalt, and copper compounds are used as the anodes. The copper is deposited on the cathode; nickel is not deposited as long as the electrolyte is acid. In order to separate every trace of copper from the solution, a carbon plate is substituted towards the end of the operation for the matte of alloy anode. A small quantity of ammonia is then added to the solution, air is passed through whilst it is being evaporated in leaden pans, the iron is separated as a flocculent hydroxide, and is removed either by filtration or by sedimentation. Pure nickel sulphate can then be obtained from the solution by concentration: the nickel sulphate solution, after being made ammoniacal, is then electrolysed with porous diaphragms. The anodes are composed of iron or zinc, as these are found not to polarise; two diaphragms are used, the solution between the two diaphragms is periodically drawn off to prevent the iron or zinc sulphate solution formed at the anode mixing with the nickel catholyte.

Farmer patented a process in 1888 for the production of nickel plate, the apparatus consisting of rollers made of a non-conducting substance, which were caused to maintain open hollow brass or copper cylinders in continuous slow rotation, which served as the cathodes. Nickel plates were bent into half cylinders and used as anodes placed beneath the lower half of the revolving cylinders. Arms fitted with rollers were caused to press against the cylinder and formed the negative contact. The solution recommended by the inventor is composed of the double sulphate or nitrate of nickel and ammonia.

Hoepfner has patented a process for using a purified neutral solution of nickel which he then acidifies with a weak and freely conductant oxygen acid (citric or phosphoric acid) which is electrolysed with the aid of insoluble anodes.

The anodes are immersed in cells containing a solution of the chlorides of a more electro-positive metal, which may be partly or wholly soluble in the solution, but in that case some metal, such as zinc, which would not be deposited with the nickel must be used.

In the commercial electrolysis of nickel, even with anodes containing as high as 96 per cent. of nickel, the anodes readily fall to pieces, owing to their uneven solution. A large quantity of anode scrap is formed, often as much as 50 per cent., this difficulty increases when matte anodes are used.

Askermann has tried fusing chromium oxide and antimony sulphide, below the fused crust of sulphides which is formed, a crystalline mass of the two metals occurs, the antimony being finally removed by oxidation or refusion. The addition of sulphides is considered to accelerate and facilitate the metallurgical reactions.

Neumann has given attention to electrolytic methods for determining nickel, which have been employed to some extent in practical analysis, viz.:—

1. Sulphate of ammonia in excess.
2. Electrolysis after converting the solution into ammonium oxilate.
3. Electrolysis of neutral nickel solution after decomposition with ammonium carbonate.

Of these methods the first is most frequently used, any iron being first precipitated with ammonia, and the filtrate electrolysed, which is not possible in the case of the oxalate method.

Neumann has used electrolytic methods with considerable success for the determination of nickel in steel, and for nickel slags.

Classen has proposed a method of depositing the nickel and iron simultaneously; dissolving the deposit in dilute acid and determining the iron volumetrically is a slow one.

A new iron alloy has been invented by Dr. Charles Gillaume that has an expansion under a rise of temperature smaller than all other alloys produced so far. The alloy consists of 36 parts of nickel and 64 parts of iron.

Seven to 10 per cent. of nickel added to aluminium forms an excellent alloy when brightness combined with hardness is desired.

The magnetic properties of nickel are interesting, numerous researches have been made on this subject. Dumont has determined the magnetic permeability for fields lying between 14 and 50 C.G.S. units, and for temperatures between — 78° and 250° C., of reversible nickel steels, containing from 27 to 44 per cent. of nickel. The variations of permeability with temperature in the maximum field are continuous, and the curves representing them are roughly parallel to each other, so that at equal distances (of temperature) from the point of total loss of magnetism, all the alloys have the same permeability. At a temperature of 20°, all the alloys show similar changes of permeability, with variations in the magnetising field, rising slowly as the field is strengthened from 14 to 25 units, then rapidly increasing to a maximum in a field of 35 units and slowly diminishing as the strength of the field is further increased. Under the same circumstances of temperature and strength of field, the permeability increases with the content of nickel.

Fine nickel is produced electrolytically at Newark, N.J., in plates $\frac{3}{8}$-inch thick; the Canadian Copper Company have also erected a large experimental electrolytic plant at Cleveland for the treatment of Bessemer nickel matte. Messrs. Gustave Menne & Co., of Siegan, are also supplying electrolytic nickel.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

The meeting on Thursday of last week, the 15th inst., was devoted to a paper on "Electric Intercommunication in Railway Trains," by Mr. W. E. Langdon. On conclusion of the reading of the paper, the President, Mr. J. W. Swan, remarked that the subject therein treated is one with which the name of Mr. Preece is inseparably connected, and he felt it would be wrong not to call upon Mr. Preece to speak, although that gentleman had just come to the meeting from a long railway journey.

Mr. Preece responded to the invitation by stating that the paper seemed to resuscitate the past. It was 34 years since he pegged away at this subject. He remembered having brought the thing to a very fair state of success when his visions were dashed to the ground by a very foolish blunder. In 1866 any application of electricity attracted attention, and the room in which he demonstrated the working of his system was crowded. The models worked well, the coupling was fixed and its action explained, but when it came to ringing the alarm was not raised, and he was laughed to scorn. He passed it off by saying that perhaps some dust had got on the stud. This at once raised prejudice against the thing, for if a little dust in the Institution of Civil Engineers interfered with the working what would be the case in practical railway use. The cause was, however, not quite so simple. Those present had been very anxious to try the apparatus before the meeting, and one of Mr. Preece's assistants had thrown the alarm out by sticking a little piece of paper on the stud with saliva!

Another trial was made later on a special train, but again something arose to sustain prejudice against electrical apparatus. It will be remembered—as explained in the paper—that the action of Mr. Preece's system depends upon two batteries being coupled in opposition, as the E.M.Fs. are equal the alarm bell does not ring until a circuit is closed between the batteries and the bells with which they are in series. In this trial a lineman was put in each van to see that everything was right, but as luck would have it, one of these men thought the bells did not ring loudly enough, and he added another battery, thereby throwing the system out of balance, and causing the bells to continue ringing, even without an alarm being desired. Again Mr. Preece was beaten, but such accidents are not likely to arise now.

Mr. Leonard wished to correct certain errors in the description of the South-Eastern Railway Company's system, as given in the paper. That in use was introduced by himself, and had entirely replaced the system attributed to Walker. The three-way switch was not indispensable, but in practice was found to be convenient. The object of the switch was to cut off the battery when a train was left in a siding—a time

when carriage cleaners and others might experiment with the alarm system and run down the battery so that when again required the alarm was found to be out of order. The switches were turned up when a train was put into a siding, and the batteries thrown out of use. It is not necessary to have batteries on every van. Wherein the complication of his system existed he failed to see. He had tried a system with but one indicator for a carriage, but the railway servants did not like the arrangement, as they had to go right through the compartments in a carriage to ascertain which alarm had been used. This meant entering, say, six compartments, and the guards did not appreciate the work at all. Formerly the battery was fixed over the fire-box. Now it was put on the tender and the connections. His predecessor used an outside disc on the carriages; it was impossible to prevent this being stolen when it was of brass, as the value of the metal was known to many persons who had access to station yards, and all efforts to trace those who removed the discs failed. Another disadvantage was that the pivots of the discs were clogged up by dust and by the alkali used for washing the carriages.

Mr. Leonard had never experienced any difficulty with a rail return when running, but when a train was standing in a station there was occasionally defective connection. He had found that electric light wire of good quality was entirely satisfactory for wiring the alarms.

Mr. Leonard thought that his system accorded with the author's views on the three considerations raised. The coupling is not, however, final, and it is the sole relic of Walker's original system. It has evidently been found useful, as several companies have imitated it.

Mr. Winter referred to his late brother's system in connection with the author's condemnation of the rails being used as a return. He stated that the use of the existing couplings on the Madras railways for the purpose of electrical connections had never once failed, and that it was impossible to break connection. Considering the stress laid upon the importance of having no additional coupling this was worthy of notice.

Mr. Wolff desired to call attention to the advantages of using a whistle to call attention, and suggested an arrangement whereby the electric current operated a relay and the alarm was given by a steam whistle. He thought electrical apparatus should be quite distinct in character, as he had known of a case where a lady attempted to stop a train by the alarm as she thought, but had turned off the hot water of the heating system instead.

Prof. S. P. Thompson drew Mr. Langdon's attention to a patent specification, dated 1852, describing an interesting and early system of railway train alarms. He then expressed the wish that writers of papers would use exactly the same terms to describe identical things. Men from different parts of the world and workers in different fields would then be able to settle upon common ideas, and if the same terms were used in the same sense, ambiguity would be avoided. He did not want to detract from the value of the paper, or to indulge in captious criticism; but at the risk of being charged with, perhaps, petty criticism, he would like to protest against the use of such terms as "commutator" for an apparatus which doesn't commute anything, but is merely a switch. Again, the phrase "open circuit" is always taken to mean, in electrical phraseology, a disjoined circuit or connections in which there is no circuit, whereas the author meant a bare or uninsulated circuit or conductor. The speaker would like to induce our friends to choose well understood terms, and was anxious that they should employ them with the same signification as electrical engineers generally do. He also pointed out that, in the United States, railway traffic working had been reduced to a civilised science. There "cars" were provided, not "coaches"—a relic of the old posting days—while electrical communication was far more general than on any line in England, electric buttons being everywhere about.

Mr. Langdon then replied. He stated his object was to place before the Institution the present condition of electrical communication between passenger and guard, so that those who were interested in the subject might have some base to work from. He was sorry more railway men had not managed to be present. It was many years since he took the matter in hand. Mr. Preece was the pioneer, and Mr. Langdon believed that there was no other basis than that Mr. Preece had laid down. The examples Mr. Preece had given thoroughly illustrated the importance of a balance of E.M.F. being maintained, and this showed the importance of using two insulated wires. He thanked Mr. Leonard for his remarks, and for the hints as to the use of the switch. As to an indicator being fitted to each carriage or compartment, the cost had to be balanced against the convenience of the guard. On all accounts, the rail return was undesirable. Referring to Mr. Winter's contribution to the discussion, he felt at a loss to understand how the current passed between tarred and sanded side chains; it was contrary to the usual notions.

Mr. Langdon then proceeded to defend his paper against Prof. Thompson's criticism. The professor had pitched into him because of the terms, but he had met with them in many books. An "open" return was, he thought, so-called because open means uncovered naturally. "Coach" was defended on the score of general usage.

Here the discussion closed. Those who were present and whose sphere of labour lay in heavy electrical engineering, seemed to be at a loss to understand why such an apparently simple problem should require such elaborate treatment. The best object lesson would be to tackle the problem when we are sure that many a sceptic would learn a good deal. We must congratulate the Institution upon the variety of subjects now being brought up for discussion. Last evening the adjourned discussion on Dr. Lodge's paper, experiments by Mr. Preece and others, and Mr. Evershed's paper were to be brought before a special meeting.

CORRESPONDENCE.

Brighton Breakdown.

In my former letter I pointed out that the facts of this mishap, which have been made public in your paper, cannot be satisfactorily explained by means of the characteristic curve.

Mr. Tapper now says that "the curve should be studied in conjunction with the *actual* facts." I have from the first been studying the matter in conjunction with the facts which he has been so good as to make public, and if he can explain in detail how to reconcile these with the characteristic curve, I am sure it will interest many beside myself. I presume there is no confusion as to the meaning of "characteristic curve." By that term I understand any one of the four curves obtained by plotting either armature current or external current as abscissæ against either E.M.F. or terminal potential difference as ordinates. Sometimes one of these four curves is the most appropriate, sometimes another.

Mr. Tapper's remarks concerning demagnetising action of armature show that he has quite misunderstood the latter part of my letter; indeed, he has quite reversed my meaning. I pointed out (in different words) that when the dynamo output is *anywhere* on the characteristic curve, the demagnetising action of the armature cannot exceed the magnetising action of the field winding to a sufficient extent to reduce the magnetic flux to zero.

So that, although for a brief time after short circuit the *net* magnetising force may be actually reversed to an extent sufficient to reverse the magnetic flux *if its application were prolonged*, yet by the time the flux has fallen to a low value, and the output has accordingly decreased and got back to the characteristic curve; the *net* magnetising force, if it still is reversed, cannot exceed the coercive force, and therefore is not sufficient to complete the demagnetisation or reversal of the field.

Consequently, as it is a known fact that short circuits are sometimes followed by loss or reversal of field, it seems not unlikely that a very heavy *momentary* armature current may affect matters in some way not yet taken into account.

As to the penultimate paragraph of Mr. Tapper's letter, I would remind him that the subject of the discussion that has arisen under the present heading is not the existence or non-existence of these effects of short circuits. All who have had much to do with dynamos know that this sort of trouble does occur.

What we want to get at is the true cause of the particular breakdown which Mr. Tapper has so kindly described to us, and which does not fit in with the usual theory.

As regards "A. D. C.'s" letter, I am not quite clear exactly what he wishes to prove or disprove, but I would point out that in practice short circuits are of varying degrees of resistance, and that a shunt dynamo, even if on absolute short circuit, still gives small E.M.F. and current though it has no terminal volts. He does not seem to have fully grasped the actual circumstances of this breakdown, as set forth by Mr. Tapper in your issue of 18th ult.

H. C. L.

An Old Question.

Please inform me through the columns of your paper whether a landlord can lawfully put down electric light plant to supply his tenants with light for their sale shops, the Corporation possessing powers, but not yet having started supply. The wires would be entirely upon his own property?

An Old Subscriber.

[There is nothing to prevent a landlord supplying his tenants with electricity, especially when the wires are on private property.—Eds. Elec. Rev.]

Which is the Best?

Referring to the inquiry by an Australian subscriber in your recent issue for best system to employ for cooling of condensing water, we beg to enclose lithos showing different types of cooling plant which we supply, and a large number of which have already been erected in this country. If your correspondent will communicate with us direct we shall be very pleased to give him full information.

The Klein Engineering Company, Limited.
Wm. Hy. Roy, *Secretary.*

Manchester.

THE BURNING QUESTION.

We showed in the Electrical Review of December 9th that the profits upon the combined electricity and destructor scheme, which a committee of the Shoreditch Vestry have to allocate, are, in fact, not yet realised. In reply, we have received letters from Mr. W. Johnson and from the chairman of the Electric Lighting Committee, to which we gave publicity on the 16th. Mr. Kershaw gives us, as a specimen of the manner in which he would reply if he took our article "paragraph by paragraph," a complaint that we did not report his answer to the auditor at the Vestry meeting held on November 15th, when that gentleman said that he had not audited the accounts. We have no intention to be unjust to Mr. Kershaw, but we must say that we are bound to believe that upon this point the auditor himself appears to us likely to be the better informed.

It is true we did not allow credit in our statement of the accounts for a saving of £1,253 over the old system of barging, and we explained why. The saving was disputed by Mr. J. J. Freeman, the chairman of the Wharf Committee, who stated that the disposal of the refuse cost his committee more than on the old system. Moreover, this saving was not credited in the revenue account of the electricity station, though it was noted separately in a later part of the report.

Mr. Kershaw admits, in effect, the accuracy of our statement of account, but, his own committee's records of profits having broken down, he now states that if the undertaking were the property of a company the interest on and repayment of capital would be available for dividend. As the Vestry is not a company, and as the ostensible profits did not include these sums, Mr. Kershaw's reply is entirely beside the point. Our criticism remains entirely unanswered, as far as Mr. Kershaw is concerned. We have only to add that we have made it clear, over and over again, that we desire no more than that the truth should be known, and that we are prepared to make complete reparation if it should be found that we have in any particular failed to serve the cause of truth on this question.

Mr. W. Johnson's letter points out that in comparing the actual results with Mr. Kershaw's figures at the opening ceremony, we omitted to say that Mr. Kershaw's statement of the actual cost of burning at 1s. 2d. per ton, including all charges, was based upon the 12-hour day for the stokers; whereas now they are working upon the 8 hours' system.

The omission, however, is not of much importance. Mr. Kershaw said the actual cost of burning, "*including all charges*," was 1s. 2d. per ton. Supposing that out of Mr. Kershaw's 1s. 2d., 10d. was for labour, leaving only 4d. per ton for all other charges, then the change from a 12 hours' day to one of 8 hours, would have increased the cost of labour by one-third, or, say, 3⅓d., making just over 1s. 5d. per ton for all charges against the present cost of over 4s. 6d. per ton. Mr. Johnson has therefore not made out much of a case to account for the discrepancy, and his answer is of small effect.

We should like to say, further, in reply to Mr. Johnson, that we have never reflected upon the common sense of the members of the Vestry of Shoreditch, who, we are glad to say, seem to be taking active steps to vindicate their position. We have dealt with this matter, as one of great public interest, to the best of our ability, and when Mr. Johnson can refute any part of our case, perhaps his remarks about our "un-journalistic" manner of treating it may appear less impertinent.

LONDON COUNTY COUNCIL.

The Council at the weekly meeting on Tuesday sanctioned an expenditure of £450 for replacing the main lift in the principal offices by means of an electric lift. It was stated by the Establishment Committee that the cost of working the electric lift would be considerably less than that of hydraulic power.

Fire Alarms and Telephones.

The Fire Brigade Committee reported that the Council in February last accepted an offer of the Post Office to provide plug-holes for portable telephones on fire alarm posts, with a view to enabling the apparatus to be utilised by firemen for the transmission of telephonic messages. Since then, the Committee stated, the chief officer of the brigade had obtained provisional protection for an improved appliance to effect this object, and the apparatus had been tried, with satisfactory results, with a fire alarm connected with the chief station. The Post Office officials were also satisfied with the experiments, and the chief officer now suggested that an extended trial should be made with the fire alarms connected with 10 stations. The Committee intimated that the Post Office authorities were prepared to fit fire alarm posts with microphones, and plug holes for telephones, and to provide plug holes in the corresponding indicators in the fire stations for an annual rental of £31 15s. per 50 posts. The Post Office authorities had also submitted an estimate for providing and maintaining portable telephones, but the chief officer suggested that these should be purchased outright at 22s. each for quantities of 50. On the recommendation of the Committee it was decided to accept the offer of the Post Office, and to purchase 50 portable telephones, with cords and jacks.

London Telephone Service.

The Highways Committee reported having had under consideration a letter from the City Corporation forwarding copy of a resolution passed by that authority, "that application be made for a license to establish a telephone service in conjunction with the London County Council and other local authorities within the London telephone area." The Corporation asked the Council to appoint six representatives to attend a conference at the Guildhall to consider the subject, and, if possible, to make the necessary arrangements. The Highways Committee recommended and it was resolved to appoint representatives to be present at the conference.

Electric Traction.

The Parliamentary Committee submitted the following report:—The Highways Committee have forwarded to us a memorandum requesting that steps may be taken for the insertion in the Council's General Powers Bill of next session of a clause or clauses to enable the Council to use electrical traction on all or any of its tramways, and for that purpose to re-construct the tram lines, and erect and place in, under, or over the roads such apparatus as may be necessary. The powers required are similar to those conferred by sections 22 and 24 of the North Metropolitan Tramways Act, 1897, excluding the proviso to section 24, which makes that section inapplicable to London. As the notices of the General Powers Bill contain no reference to this matter, the desired power can only be obtained by means of a petition to Parliament for leave to insert additional provisions, or by the promotion of a separate Bill, which will require a suspension of the standing orders of Parliament. We are not prepared at

once to decide which of these courses should be taken, but having regard to the urgency of the request of the Highways Committee, we think we should be authorised by the Council to give effect to their wishes, and we recommend—That the Parliamentary Committee be authorised to seek powers in the next session of Parliament, either by a separate Bill or by the insertion of provisions in the General Powers Bill, to enable the Council to use electrical traction on all or any of its tramways, and for that purpose to re-construct the tram-lines, and erect and place in, under, or over the roads such apparatus as may be necessary.

LEGAL.

Electric Construction Corporation *v.* The Imperial Tramways Company, Limited.

This is an action for injunction to restrain the defendant company from infringing a patent in connection with electric tramways; and on Friday, December 16th, a motion for interim injunction, pending the trial of the action, was mentioned before Mr. Justice Stirling in the Chancery Division of the High Courts.

Mr. Fletcher Moulton, Q.C., M.P., for the plaintiffs, said that further affidavits had just been filed by the defendants, which the plaintiffs had not had time to answer, and, therefore, they were not ready to proceed with the motion. To save the time of the Court, however, he would suggest that, there being a question to be tried, the motion should stand over till the trial, and that the trial should be advanced.

Mr. Jenkins, Q.C., for the defendants, said he could not assent to the course suggested. He saw no reason why the case should not take the ordinary course now, as the matter had been going on for four years.

Mr. Moulton remarked that the patent was one of very old date.

Mr. Jenkins said it would expire next August, but if the plaintiffs proved damage the Court would give them their relief.

His Lordship said he saw no reason why the action should not be at once set down for trial, with liberty to the parties to apply to have the trial advanced. In the present state of business in his Court, however, he could not hold out much hope that the case would be reached before next August.

It was accordingly arranged that the motion should stand over until the trial, with liberty to apply to have the trial advanced.

Gold *v.* Winter.

In the Westminster County Court on Friday last, the case of Gold *v.* Winter came before His Honour Judge Lumley Smith, Q.C., which was a claim for £75, balance of a commission of £100, in reference to an electric light order.

Mr C. P. Rose-Innes was counsel for the plaintiff, and said the claim was for £75, which was the balance of £100 commission due to the plaintiff. It seemed that in 1891 the Chiswick authorities had obtained a provisional order, and Messrs. Bourne & Grant had obtained the option under that. Nothing much had been done, and the Chiswick Council was afraid they would lose it. His client came upon the scene, and defendant arranged to pay him a salary and £100 as commission upon each provisional order he was instrumental in introducing to him, and which he obtained the option of. He went to many places, and among them Chiswick. He saw an electrical engineer—a Mr. Trentham—and he thought he would be able to do something in the matter. By the introduction thus brought about the provisional order was obtained by the defendant from Bourne's. All his client had had was £25.

Henry S. Gold, of 120, Ackerman Road, Brixton, gave evidence that the interview took place at defendant's office in Norfolk Street, Strand, in the presence of Mr. Pressland. He then deposed to the arrangement stated by his counsel. In consequence of this arrangement he asked him to go to Chiswick, but he said he thought it was useless, but he went and saw Mr. Trentham, and he communicated with Bourne & Grant, and placed Mr. Trentham in communication with the defendant, and told defendant Mr. Trentham knew someone at Bourne's, and he thought that through him he would be able to get this business. Defendant subsequently got the option of the order, and that he sold to Mr. Brooke-Hitching, and for that he got £1,000 in cash, and if a company was formed within six months he would get £1,000 in shares; if not, he would have the cash. He believed he had had the whole £2,000. Defendant discharged him after paying him £25, because he had stood up for Mr. Trentham, who had only come into the business on condition that he was to be the consulting electrical engineer in the matter.

His Honour: Has Chiswick got the electric light yet?

Mr. Rose-Innes: They are playing with the option. It has been resold for £5 000.

Cross-examined: Mr. Pressland was an engineer, and was present at the conversation when the arrangement was made at the defendant's place in Norfolk Street. Defendant promised him a salary of £3 a week and all disbursements and £100. He entered into an engagement with Messrs. Sax, and there was an action which was settled. He had been secretary of the Lambeth Ratepayers' Association for three years, which body was opposed to a monopoly, and wanted the parish to have the control of the lighting itself. It was absolutely untrue that he used his position as secretary to the Lambeth Association to further the interests of Messrs. Sax. He absolutely denied it. Mr. Winter was connected with Lambeth. He introduced Mr. Trentham to Mr. Winter, and Mr. Trentham brought the matter about by introducing Mr. Winter to Bourne's. Defendant paid him his salary all through.

Mr. Trentham, a mechanical engineer, of Victoria Street, S.W., said plaintiff called upon him, and eventually he was introduced to the defendant, who, though he had seen him before, there had been no business relations between them. Through this he introduced defendant to Mr. Marks, of Bourne's, and he was to be appointed consulting engineer to the new company. He was not, so he brought an action against defendant and Mr. Brooke-Hitching, which was settled before going into Court.

Cross-examined: He knew the engineer at Bourne's, and he introduced defendant to Mr. Marks in December last or January of this year. He knew those gentlemen were not acquainted with one another. He had made Mr. Marks's acquaintance just before. He introduced the business through Mr. Gold. He had never paid Gold anything on account of Chiswick. Plaintiff was in his employ in July at a salary.

Mr. Rose-Innes called Mr. Brooke-Hitching, who did not appear, and a solicitor on his behalf said there was no need, as he produced the agreement. Mr. Brooke-Hitching did not know so much about it as he (the speaker), and it was only done with another object, viz., to bring pressure to settle the action. He produced the agreement.

Mr. Rose-Innes said that was all he wanted, and it was put in.

His Honour said Mr. Pressland must be present, and he would take the evidence of such of the defendant's witnesses as was desired.

Mr. G. Croydon Marks, a consulting engineer in London and Birmingham, said in 1896 he was acting for Mr. Bourne, who was the largest shareholder in Bourne & Grant, Limited, and he had instructions to sell the option, owing to the death of Mr. Grant. This was advertised and he received several replies, but the purchase was not carried out until 1897. He first saw defendant in December, 1897, and at that time he had not seen Mr. Trentham or heard of him. Defendant came alone to see him, and he said, in answer to witness's questions, the matter had been brought under his notice. This was not a sale of the option, but of the shares of Mr. Bourne in the company. A few days later he called again with Mr. Trentham. The sale took place to Mr. Winter.

By his Honour: Those who bought the shares really bought the option.

Cross-examined: The option would have expired in two months from the date of sale. His company got the option in 1893. Winter sold to Brooke-Hitching. The assets of this company included provisional orders at Aberystwyth and Chiswick. Instead of Trentham bringing Winter it was the other way about.

The case was adjourned for the attendance of other witnesses.

BUSINESS NOTICES, &c.

Agency Notice.—The firm of Heddernheimer, Kupferwerk vorm F. A. Hesse Soehne, Heddernheim, nr. Frankfort, have appointed Messrs. De Grelle, Houdret & Co., of 130, London Wall, E.C., agents for the United Kingdom. A list has just been brought out in English, giving particulars of their copper sheets, discs, rods, wire and wire ropes, fire box, stay rods, &c. In tabulated form details are given of breaking strain and resistance, weights and sections of copper and bronze wires.

American-made Electrical Machinery.—Writing upon the very interesting subject of exports of American electrical machinery, *Sell's Commercial Intelligence* says that the American exports of electrical machinery in 1898 are likely to total out much in excess of those of any previous year. The trade is growing, not only with England, but with the British colonies, especially with South Africa and New Zealand. The growth of this industry in the United States, in fact, is so large and so general, that scarcely a vessel leaves New York in which there are not large consignments of electrical machinery and electrical appliances. The mines in the neighbourhood of Johannesburg have recently made large calls on the American manufacturers, and at Cape Town and Port Elizabeth the electrical plants for street tramways have been installed by American firms. Cotton mills in India, Japan, and China have also been fitted with electric lighting machinery from the United States, and American electric locomotives for use in mines are being sent to all parts of the globe. Excepting the steel and oil refining industries, there is no industry in the United States which prides itself more on its ability to possess itself of the trade of the world than the electrical industry. American manufacturers of electrical machinery now assert that they fear no competition, except that of other firms in the United States; in short, that the world is theirs. When asked for reasons for this supremacy over England, they reply that England has comparatively few large plants for turning out machinery of this kind; that American machinery is both cheaper and of better workmanship than electrical machinery made in England, and that some of their advantage is due to the conservatism of the English people in adopting new devices. This conservatism, they explain, has so far accounted for the comparative smallness of the demand for electrical machinery in England.

Bronze Medal.—We are informed that the "Stewart" enclosed arc lamp was awarded a bronze medal at the Esposizione Generale del 1898, which has just been held at Turin. We understand that this was the only medal awarded for enclosed arc lamps.

Electrical Wares Exported.

Week Ending Dec. 20th, 1897	£	s.
Adelaide...	17	0
Amsterdam	45	0
Antwerp...	105	0
„ Elec. cable ...	900	0
Bangkok	413	0
Beira	122	0
Buenos Ayres. Teleg. mat.	100	0
Brussels	210	0
Calcutta...	211	0
Cape Town	34	0
Colombo...	62	0
Delagoa Bay. Teleg. mat.	180	0
Durban	1,310	0
„ Teleg. mat. ...	670	0
Flushing	65	0
Fremantle	319	0
„ Teleg. mat....	1,145	0
Geraldton	60	0
Gibraltar	227	0
„ Elec. cable ...	2,300	0
Gothenburg	43	0
Hiogo	35	0
Hobart	49	0
Madras	196	0
Melbourne	49	0
Nagasaki. Teleg. cable	9,000	0
Odessa	180	0
Port Elizabeth. Tel. mat.	121	0
Rotterdam	11	0
St. Petersburg	382	0
Shanghai	656	0
„ Teleg. mat....	137	0
Singapore	70	0
„ Teleg. mat....	25	0
Sydney	423	0
Townsville	140	0
Wellington. Teleg. mat.	1,808	0
Yokohama	379	0
Total	£22,199	0

Week Ending Dec. 20th, 1898.	£	s.
Adelaide	53	0
Amsterdam	55	0
Antwerp...	65	0
Auckland	223	0
Bombay	240	0
Boulogne	60	0
Brisbane	129	0
Calcutta	846	0
Cape Town	144	0
Chinde	16	0
Christiana	45	0
Colombo	69	0
Copenhagen	23	0
Durban	29	0
East London	361	0
Ghent	195	0
Halifax	27	0
Hamburg	120	0
Hobart	103	0
Malta	223	0
New York	36	0
Ostend	36	0
Port Elizabeth	95	0
Rangoon	92	0
Shanghai	30	0
„ Teleg. mat....	147	0
Singapore. Teleg. mat.	117	0
Suez. Teleg. mat. ...	516	0
Sydney	41	0
„ Elec. cable ...	1,625	0
Vigo. Teleg. mat. ...	45	0
Wellington	49	0
„ Teleg. mat....	579	0
Total	£6,414	0

Foreign Goods Transhipped.

	£	s.
Stockholm	£50	0
Total	£50	0

	£	s.
Bombay	£50	0
Brisbane. Teleg. mat....	148	0
Sydney	541	0
Total	£739	0

Bankruptcy Proceedings.—The Official Receiver for the Rochester and Maidstone districts (Mr. R. T. Tatham) is now going into the affairs of Mr. Thomas King, of St. Peter Street, Maidstone, engineer, who has just filed his own petition in bankruptcy. The debtor commenced business in October of 1893, at 29, Western Road, Brighton, as an electrical engineer, with about £500 capital. He subsequently removed his business to 126, Western Road, Brighton, and since then has been in business at Maidstone. According to the debtor's statement of affairs, his gross liabilities are now £2,497 19s. 6d. There are 134 unsecured creditors, to the amount of £2,103 13s. 5d. Three creditors are fully secured (£368 2s. 7d.) with an estimated value of securities £538 2s. 7d.; on the other side, the assets show £1 13s. 9d. cash at bankers; £250 worth of stock and machinery; £25 furniture; good book debts, £570 8s. 6d.; doubtful debts, £306 17s. 7d.; and bad debts, £211 1s. 6d. The deficiency is stated to be £994 1s. 6d. The debtor gives as the causes of failure losses in his Brighton business and insufficient capital for the Maidstone branch. The first meeting of creditors is to take place at Bankruptcy Buildings, Carey Street, Lincoln's Inn, London, on 22nd inst., at 11.15 a.m., and the public examination of the debtor is fixed for January 4th next at Maidstone, at 12 o'clock. On September 27th last a meeting of creditors was held at 9, Fleet Street, London, at which an approximate statement of debtor's assets and debts was submitted, showing assets £2,442 3s. 9d., and liabilities £2,117 2s. 9d. It appears that at a subsequent meeting the creditors agreed to accept an offer of 20s. in the £ by instalments at 4, 12, and 18 months, provided debtor executed a deed of assignment. This he seems to have declined to do, and the deed was therefore not executed. The debtor has been pressed and sued by several creditors lately. A bankruptcy petition was presented by one creditor, but that was dismissed, because a receiving order had already been made against debtor. It is stated by the debtor that he filed a petition in the London Court about the year 1880, and he obtained his discharge in respect of that petition on September 17th, 1884. Debtor has kept a number of books.

Under the failure of R. M. Houldsworth, company promoter, 7, Fenchurch Avenue, E.C., the debtor attended last Monday for public examination at the London Bankruptcy Court. In the course of his evidence the debtor said he was associated with the promotion of the British Steam Generator and Refuse Utilisation Company, Limited, formed to work Livet's patent for producing electric light from town refuse. He made a loss of £5,630 over that promotion, and a considerable portion of his present liabilities related to the patent and undertaking. His accounts showed liabilities £19,189, ranking against assets £3,909, but the creditors had accepted a scheme providing for a composition of 7s. 6d. in the £, claims for about £9,000 being first withdrawn. The examination was concluded.

The creditors of Edward Baldwin Pym, electrical engineer, Bramham Gardens, South Kensington, late of Bar Chamber, Scarborough, met at the London Bankruptcy Court on Monday last before Mr. Wildy, official receiver. The receiving order was made on the petition of Mr. G. H. Berkin, restaurateur, 263, Regent Street, a creditor for £184. It was stated that although the debtor was represented on the petition, he had not surrendered under the proceedings, and was believed to be now at Monte Carlo. A representative from the office of Messrs. Tatham & Pym stated that the debtor was in receipt of an income under the will of the late Wollaston Frank Pym, Esq., of which Mr. Guy Pym, M.P., was the executor, but the income was alienable on bankruptcy. The meeting was adjourned to January 9th next, to enable other creditors to be present.

Liquidation Notice.—At meetings held at Birmingham on November 23rd and December 8th, the members of Chamberlain and Hookham resolved to wind up voluntarily for the purpose of reconstruction upon the terms of an agreement submitted. Mr. J. Brown, of New Bartholomew Street, Birmingham, was appointed liquidator.

Books Received.—"Centrifugal Pumps, Turbines, and Water Motors," by C. H. Innes, M.A. Manchester: Technical Publishing Company. 3s. 6d.

"The Christmas Catalogue of the *Newsagent and Booksellers' Review*." 190, Fleet Street, E.C. 1s. Containing brief notices of and copies of pictures appearing in many of the new Christmas books and magazines.

"Electro-plater's Handbook," by G. E. Bonney. Third edition. London: Whittaker & Co.

The British Schuckert Electric Company.—As was stated in our issue of December 9th, the British Schuckert Electric Company, Limited, has been registered in London with a capital of £200,000, the whole of which has been privately subscribed. The new company, which is promised very influential support, will devote itself principally to the working of concessions for electric tramways and central stations, as well as to the supply of plant for chemical and other industrial purposes. The fact that the company has at its disposal the valuable technical knowledge and experience of the well-known Continental firm, the Electrizität's Aktien Gesellschaft vormals Schuckert & Co., of Nuremberg, is in itself a good recommendation and a fair augury for its success.

Lists.—Owing to improvements and economies effected in the manufacture of some of their standard machines, Messrs. Crompton & Co., Limited, are enabled to send out a list of revised prices and corrected slips for use in connection with their catalogue.

The International Ventilating and Engineering Company, Limited, have sent us lists of Thompson's improved systems of ventilation and electric air propeller.

Ediswan Entertainment.—The annual entertainment given by the Edison & Swan United Company to their employés is to be held to-night at Stratford Town Hall, West Ham.

The Electric Construction Company, Limited.—A general meeting of the holders of the second mortgage debentures of the Electric Construction Company, Limited, was held at Winchester House, E.C., on Wednesday, 21st inst., for the purpose of passing an extraordinary resolution accepting an offer made on December 1st, 1898, by the Electric Construction Company, Limited, to the trustees (the Electric and General Investment Company, Limited) to pay off on January 1st, 1899, the outstanding balance of that company's 6 per cent. second mortgage debentures at the rate of £103 per cent. and interest to December 31st, 1898, inclusive.

Electricity in a Paper Mill.—A large electric power transmission plant is being installed in the works at Gratwein, of the Leikam-Josefsthal Papier Gesellschaft, by Messrs. Ganz & Co., of Buda-Pesth. The plant will comprise a 1,000-H.P. compound engine, and a 1,000-kilowatt three-phase alternator.

Fined.—On 20th inst., at Burslem, H. B. Phillimore, electrical engineer, described as manager to Messrs. R. W. Blackwell and Co., contractors for the British Electric Traction Company, was summoned at the instance of the Burslem Town Council for unlawfully obstructing the footway in Waterloo Road by making an excavation therein. For the purpose of carrying the overhead wires for the tramways, poles had been erected and defendant ordered his workmen to rectify one of these poles, without giving due notice to the boro' surveyor. Evidence was given to show that several people had sustained injury through falling into the hole, which was from the 2nd to 5th inst. covered with loose boards. On 5th inst. the surveyor had the hole filled up. A fine of 20s. and costs for each offence was imposed—£5 14s. 6d. altogether.

Large Order for Parsons Turbines.—The following extract from the *Pittsburg Times* of December 2nd, 1898, is interesting as showing the increasing popularity of the Parsons steam turbine:—"The United Electric Light and Power Company of New York gives a rush order for a 2,500 horse-power Parsons turbine engine, to be followed by four other monsters! Westinghouse Air Brake Company will also displace steam engines for them. Their surprising capacity and economy demonstrated! Great new industry here probable! The Westinghouse Machine Company has just received contracts for what are probably the largest turbine engines in the world. This is practically the first introduction in this country of this wonderful engine, and its manufacture promises to result in the establishment of one of Pittsburg's greatest industries. The

remarkable success attained by Charles A. Parsons with his turbine engine on the English torpedo boat *Turbinia* has demonstrated the surprising capacity and economy in their use over ordinary steam engines, and in consequence the Westinghouse Machine Company, which owns the patents for the United States, has determined to push their manufacture and introduction here. The Westinghouse Machine Company is now building three turbine engines, of 500 horse-power capacity each, to drive generators and Tesla motors to be furnished by the Westinghouse Electric and Manufacturing Company, for the replacement of a large number of steam engines at present used to drive the machinery of the air-brake company at Wilmerding. The Machine Company is also constructing, under a rush order, a Parsons turbine engine, the first of five of 2,500 horse-power each, to drive a 1,500-kilowatt multiphase generator for use by the United Electric Light and Power Company of New York City, which company will instal it on a block of land adjacent to its new station on the Twenty-eighth Street and East River. The capacity for this station has already been fully absorbed by the demand for electric light and power. These five new outputs, of an aggregate capacity of 12,500 horse-power, will raise the Twenty-eighth Street station capacity of the United Company to 20,000 horse-power, and will leave available the site of the adjacent Twenty-ninth Street station, the use of which was discontinued on Wednesday. Mr. Parsons, the inventor of this type of engine, claims that it is much more economical in the use of steam than the ordinary type of engines, with the further advantage that the water, or condensation, may be safely returned to the boiler, since no oil whatever enters the engine while it is in operation. An advantage from the use of these turbine engines and generators may be appreciated from the fact that the five engines and generators of aggregate capacity of 12,500 horse-power can be placed in about one half the space now occupied by eight vertical engines of 1,200 horse-power, each with Westinghouse generators, now in operation at the Twenty-eight Street station. The Westinghouse Companies are said to be largely interested in the United Electric Light and Power Company."

Power Supply.—The County of London and Brush Company are distributing circulars in the St. Luke's, Clerkenwell, and Holborn districts, bringing to the notice of residents the great advantages of electricity as a motive power. Such matters as space occupied by motors, economy in cost and attendance, and convenient operation are referred to, and names of makers of motors, with the prices of same are given. The company charges 2d. per unit after the first hour at 6d.

Receiving Order.—A receiving order was granted on December 14th on a creditor's petition in *re* J. E. Liardet, engineer, of Hyde Park Gate, Kensington Road.

Wild v. County of London and Brush Company.—At the City of London Court on 19th inst., plaintiff, a labourer, sought to recover £50 damages for personal injuries caused by an explosion at a transformer box in John's Street Road, on July 22nd. The defence was that the plaintiff ought to have worn the rubber gloves provided for him. Judgment for plaintiff for £15.

ELECTRIC LIGHTING NOTES.

Alloa.—The Burgh Commissioners last week resolved to adopt B scheme in connection with the proposal to introduce electric light into the burgh, the initial cost to be £8,000.

Ashton.—Among the matters embodied in the minutes of the Electricity Committee as adopted by the Council last week was a proposal to appoint an assistant electrical engineer at £130 per annum. The British Insulated Wire Company was requested to submit prices for laying and making house service connections, and that the matter be decided by the Works Sub-committee. The town clerk forwarded correspondence between the Oldham, Ashton, and Hyde Electric Tramway, Limited, Mr. Clirehugh, and himself, relative to the date when the Corporation would be in a position to supply current. It was resolved that the town clerk be instructed to report on the agreement between Mr. Clirehugh and the Corporation at the next meeting. That three months' notice be given or taken to determine the engagement of the borough electrical engineer. It was resolved that the minimum charge of 13s. 4d. per quarter for electricity be abolished and struck out of the list of conditions. These matters were all approved by the Council.

Barnsley.—The following tenders are, according to an exchange, recommended for acceptance for the supply of plant, &c., for the electricity works for the Corporation:—(Contract No. 1) W. Arnold & Co., boilers, £3,260; (2) Johnson & Phillips, engines, dynamos, plant, &c., £8,030; (3) Pritchetts & Gold, storage batteries, &c., £1,319, and £70 per annum for annual maintenance of batteries; (4) British Insulated Wire Company, electrical mains, &c., £6,322 4s. 2d., and £110 per annum for maintenance.

Bath.—At the City Council on 13th inst., in the course of a discussion *re* electric lighting matters, reference was made to Mr. Hammond's appointment as consulting engineer, several speakers saying that his services were no longer necessary. In the end Mr. Bush said that the Electric Lighting Committee had already taken steps in regard to the transfer of the duties now undertaken by the consulting engineer to the city electrical engineer. A report is being prepared on the subject.

Belfast.—The total number of lamps now connected is 35,004, while there are 5,649 applied for, making a total of 40,653 8-candle power.

Bermondsey.—The Electric Lighting Committee reported to the Vestry on Monday having received a letter from the Lee Board of Works, stating that it appeared to them that it would be convenient for representatives of the local authorities affected by the application of the County of London and Brush Provincial Electric Lighting Company for a provisional order, to meet in conference to consider the course to be adopted in regard to the matter. The Board pointed out that the districts concerned were Bermondsey, Deptford, St. Paul's and St. Nicholas, Deptford, Lambeth, and Lewisham, and they invited the Vestry to appoint one member with the clerk or other officer, to attend the conference to be held on January 5th. The committee stated that they had instructed the vestry clerk to reply that they had already decided to oppose the company's application, and that they did not see that any benefit would accrue by attending the conference. On the motion of Mr. Cox, chairman of the committee, the Vestry approved the adoption of this course.

Bolton.—Mr. Arthur Ellis, the borough electrical engineer, and the electricity works staff are now busily engaged extending the electricity works in order to accommodate two 1,000-H.P. engines and two 500-H.P. ditto, together with two 600-kw. and two 300-kw. continuous current generators for tramways and lighting purposes. It is intended to change over portions of the town to continuous current, leaving the present alternating current plant to supply the residential districts. This will take place during next summer. It is hoped to have the trams running next year (35 miles of track). Besides the above plant, there are three Lancashire boilers in order, 30 feet × 8 feet, together with superheaters, economisers, mechanical stokers, &c.

Bradford.—The printing works of Messrs. John Dale and Co., Limited, Bradford, have been equipped with electric lighting and driving plant. All the machines are driven by electric motors. The work was done by the Eclipse Brass and Copper Company.

Brentford.—The Middlesex County Council has referred it to the county solicitor to take the necessary steps with a view to obtain clauses excluding Brentford and Kew county bridges from the operation of the Brentford provisional order.

Brighouse.—The Electric Lighting and Destructor Committee has just visited Wakefield and Oldham.

Brighton.—During November the Lighting Committee appointed certain of their members to consider the question of appointing a deputy manager to take charge of the electricity works during the absence or illness of Mr. Wright, managing engineer, and applications by Mr. C. C. Fowler, mains superintendent; Mr. W. P. Tapper, electrical house fittings inspector; and Mr. Joyce, chief clerk, for an increase in their salaries; also as to the terms and conditions upon which the several officers employed on the electric lighting undertaking hold their respective appointments. As the result of their deliberations the sub-committee did not at the present time advice the appointment of any deputy manager, on account of the organisation of the undertaking, and the experience of Messrs. Fowler & Tapper. They suggested, however, an increase of Mr. Fowler's salary from £3 10s. a week to £225 per annum, rising in 12 months' time to £250; that Mr. Tapper's salary be raised from £2 15s. a week to £175 per annum, rising by annual increments of £25 to £250; also Mr. Joyce's salary be increased from £2 10s. a week to £150 per annum. With reference to the terms and conditions upon which the several officers of the undertaking are employed, the report was that the whole of the staff, with the exception of Mr. Wright, are weekly servants, and that Mr. Wright's engagement is determinable by one month's notice. It was not proposed to alter his agreement. The Lighting Committee adopted all the suggestions of their sub-committee. The Council last week passed these recommendations after discussion.

Camborne.—The District Council has resolved to assent to the proposed application of the Camborne Electricity Supply Company for a provisional order, on certain conditions.

Canterbury.—The National Electric Free Wiring Company, Limited, have established a branch at St. George's Lane, Canterbury, and are executing numerous orders for fitting premises with wires, &c., and other classes of electrical work.

Cardiff.—At a recent Town Council meeting, on the minutes of the Finance Committee being considered, Mr. Good objected to the payment of a sum of £885 to Messrs. Ferranti on certificates 1 and 4 of their contracts. Owing to the delay in completing the work, he contended that the Corporation had lost £3,000 in revenue, and if they paid this money it would leave the Corporation without remedy, inasmuch as the amount of penalty was so large. The engine in question had been two years and eight months in course of erection, and he asked that the payment should not be made until the completion of the contract.—Mr. Applebee, the engineer, said he was perfectly satisfied with the construction of the machine, and it was doing good work at present. There were certain details which he suggested could be improved, and the contractors decided to carry them out. The usual 10 per cent. retention money had been reserved. Mr. Mildon asked whether these alterations were to be made at Ferranti's expense, and Mr. Applebee replied in the affirmative.—After discussion, Mr. Good's resolution was defeated.

Carlisle.—Last week the Council adopted a report of the General Purposes Committee, which stated that Messrs. Cowans, Sheldon & Co. had asked whether the Corporation were prepared to supply them with electric motive power and upon what terms; and the committee had decided to supply electric current for motive power at a cost of 2d. per unit for the first 100,000 units per annum (460 volts), and had referred the question of what reduction should be made in the event of more than that quantity being consumed, and what the charge ought to be in the case of the consumption being less, to a sub-committee to consider and report thereon. The tenders of Messrs. Mackenzie Brothers for the supply of special arc lamp-posts for the fountain in Court Square for £16 and of Messrs. Crompton & Co. for special arc lamp ornamental bracket to be fixed on the existing pillar in the Market Place for £5 in accordance with designs by Prof. Kennedy had been accepted. The electrical engineer had been authorised to advertise for a staff for his department. He had also been requested to obtain from the different contractors various descriptions of necessary plant at a cost of £825; and to extend the electric lighting cable from Lowther Street to St. Paul's Square. The rent for the use of electricity meters had been fixed at 10 per cent. of the cost. The minutes of the committee contained the report of the sub-committee upon various systems of electric traction in operation in a number of towns, and also the committee's resolution recommending the adoption of the overhead trolley system, following closely the lines of that in operation at Dover, provided the Tramway Company undertook to obtain the electric current from the Corporation upon terms to be hereafter agreed upon, and subject also to such other conditions as the town clerk might consider necessary in the interests of the city. The Council had a long discussion *re* the trolley tramway question, and the recommendation of the committee was carried unanimously.

Chatham.—Mr. John Hewett, C.E. (of the firm of Messrs. Harrap, Hewett & Duffield) has been appointed consulting engineer to the Town Council for the electric lighting of the new Town Hall, now in the course of erection on the Military Road, Chatham.

Chester.—Last Friday a Local Government Board inquiry was held *re* the Council's proposal to borrow £20,000 for electric lighting extensions. The town clerk said the Council had already had loans amounting to £45,000, but had incurred an expenditure, owing to the laying of extra mains, lamps, &c., of £48,123. They were constantly receiving applications for extensions of the light to various districts in the city. At the last meeting of the Lighting Committee an application was received in respect of Parkgate Road. The Committee were contemplating extending the light to Handbridge, Eaton Road, Queen's Park, &c.

Colwyn Bay.—Last week it was resolved that the Council, acting under the advice of Mr. Clirehugh, carry out an extension of the electric lighting, and that the cables (for public and private purposes) be confined to the main road from Coed Pella Road to Greenfield Road, Station Road, and Penrhyn Road.

Dover.—The Town Council has resolved to light the police station, Court Hall, and the various rooms of the municipal buildings by electricity.

Eastbourne.—The Town Council last week passed a resolution applying to the Board of Trade for a provisional order. It was remarked by the mover of the resolution that the application could be abandoned at any time if they came to an amicable arrangement with the electric light company.

Epsom.—The Lighting Committee of the District Council recently visited Harrow for the purpose of obtaining reliable information in regard to electric lighting, as the population of that town is nearly the same as at Epsom, and came to the conclusion that electric lighting was desirable for Epsom. Mr. Hawtayne's 1896 report to the Council was looked up. In that report the estimated cost of the undertaking was given as £14,980, and the estimate of the probable receipts £2,178. The plant as arranged would be of ample size to deal with the whole of the public lighting in addition to providing 5,000 private lamps, and room would be left for putting in an additional plant when required. The committee recommended that Mr. Hawtayne be instructed to prepare specifications of the necessary works to be carried out in all the streets mentioned in the compulsory area, and the whole of the district as at present lighted by public lamps; that tenders be advertised for. In view of the importance of the matter, a special Council meeting was to be held yesterday to consider it.

Fladbury.—The Parish Council has been considering the lighting question. Some members have been recommending the use of local water-power in connection with electric lighting.

Gillingham.—The Survey Committee last week advised the District Council that the question of lighting the streets with electricity be adjourned, the clerk to prepare a return giving the relative cost of electricity and gas. This has been agreed to.

Greenock.—In submitting a preliminary report for the electric lighting of Greenock, Mr. Fedden, engineer, suggests that 44 public lamps be erected between James Watt Dock and Grey Place, to take the place of 80 gas lamps on the main line, and about 40 down the side streets. The plant, including mains and buildings, is estimated to cost £25,000, and spare ways about £5,000 more.

Hackney.—The Kingsland Steam Works, Limited, have asked the Hackney Vestry to allow the Shoredich Vestry to supply their premises with electricity. As the works are in the Hackney district the Vestry has declined to consent. It is to be hoped that the Hackney Vestry will soon be in a position to proceed with the erection of plant, &c., for its own installation. It has been delayed far too long already, seeing that the Vestry was elected primarily for the purpose of installing a municipal lighting plant.

Hampstead.—So successful has been the electric lighting undertaking of the Hampstead Vestry, that the Committee reported at the last meeting that, owing to the great increase in the number of consumers, they were of opinion that it was necessary to now make provision for the extension of the buildings at the central station. In support of this opinion they stated that:—

The station commenced with plant capacity of	420	kw.
In August, 1895, a further plant was ordered, of capacity	200	„
„ May, 1896 „ „ „ ...	300	„
„ November, 1896 „ „ „ ...	300	„
„ April, 1898, two further plants were ordered, of capacity	700	„
Which, when complete, will give a total of	1,920	„
Of the original 420 kw., a 20-kw. plant has been sold ...	20	„
Leaving	1,900	„

while at the end of 1895 there were only 246 consumers with 19,407 8-C.P. lamps, there are now 1,145 consumers with 74,000 lamps. This large increasing ratio prompted them to report: "That they had considered various alternative schemes for extending the buildings and providing the plant necessary to meet the possible demand, and were of opinion that the best mode is by the erection of two boiler houses, with engine room in centre, capable of eventually containing 4,000 additional horse-power; this would give about 2,500 kw. capacity, with exciters, &c., and, with the present plant, supply a total of about 248,000 8-C.P. lamps;" and they therefore recommended "that the Lighting Committee be authorised to prepare and lay before the Vestry plans for the extension of the central station, with a view to the provision of additional plant of 4,000 horse-power for both engines and boilers." After a long discussion the Vestry decided that this should be done.

At the same meeting the Vestry settled the vexed question of a reserve fund for their electric lighting undertaking by deciding almost unanimously: "That the whole of the net profits from time to time be set aside to form a reserve fund until the same reaches 10 per cent. on the capital outlay, and that such profits be invested as and when the Finance Committee shall decide and in such securities as the Vestry may from time to time think fit." In the course of the discussion, it transpired that the net profit from the inauguration to Lady Day, 1898, was £2,820 13s. 1½d., made up as follows:—Profit on second 15 months' working (to March, 1897), £1,831 15s.; profit on 12 months' working (to March, 1898), £3,905 3s. 4d. = £5,736 18s. 4d.; less deficit on first 15 months' working (to December, 1895), £2,916 5s. 3d.; net profit at March, 1898, = £2,820 13s. 1d. These figures do not include the aid received from the lighting rate, £1 659 5s. 11d., for the reason that at the meeting in question the Vestry decided that this sum be at once recouped to the lighting rate out of the electric light revenue account.

Haslingden.—At a recent meeting of the Town Council, the Mayor remarked that if the electric lighting scheme proved a success, it was proposed to extend the use of electricity to the running of the trams. Consequent on the proposal of the Accrington Town Council to buy out the company, there has grown among the Haslingden Town Council a feeling that inasmuch as the several Corporations through whose boroughs the company run have certain powers of purchase the company ought, when the time comes, to be bought out by the Corporations jointly. Each could supply electrical energy from its own electrical stations, for Accrington, Haslingden, and Rawtenstall are each seeking powers to provide the electric light.

Hyde.—The Town Council will not consent to the application by the Electrical Power Distribution Company for a provisional order, as it has a scheme of its own under consideration.

Ilfracombe.—The gas company was on Monday to have had an interview with the District Council with respect to electric lighting.

Kensington and Notting Hill.—At the meeting of the Kensington Vestry on 14th inst., the Law and Parliamentary Committee presented a report dealing with the Kensington and Notting Hill Electric Light Bill, in which they stated that the scheme contemplated the purchase of land in various parts of the parish for the erection of generating stations, and that the Vestry would be returned as dissenting from the scheme with the object of securing their *locus standi*, and the Committee had given directions for the notice and plan to be brought before the Special Electric Lighting Committee for their consideration in connection with the negotiations which are at present proceeding between that Committee, on behalf of the Vestry and the company.—Mr. Leach stated that he had received a large number of protests with regard to the site, and he moved that, with reference to this particular site, it should be referred to the Law and Parliamentary Committee to consider the serious objections which were likely to be argued by the residents, and to report as to the Vestry offering this portion of the scheme the most strenuous opposition. After discussion the motion was carried.

Kingswood (Bristol).—An accident at Kingswood extinguished the electric lighting there on Monday evening. The system has no connection with the electric lighting at Bristol, and the conductors are carried overhead, the streets being illuminated by incandescent lamps. A runaway horse harnessed to a trolley collided with one of the pillars and overturned it. The strain brought down

several other poles, and it is said the lighting wires in their fall came into contact with the trolley wires of the Kingswood and Bristol tramway. The electric lighting current was turned off, and part of Kingswood streets plunged into darkness.

Leeds.—The purchase of the Yorkshire House-to-House Electricity Company's business was completed by the Leeds Corporation on Thursday, December 15th. The total amount of money transferred for the undertaking was £222,987 18s.

The Corporation Electric Lighting Department is sending out notices to the effect that "the undertaking of the Yorkshire House-to-House Electricity Company, Limited, has been transferred to the Corporation as from October 1st, 1898. Accounts for goods supplied and work done on and after that date should be rendered to the Corporation at 1, Whitehall Road, Leeds."

Limehouse.—The District Board of Works Works Committee has considered the question of applying for a provisional order for electric lighting, and has further adjourned the matter.

Lincoln.—Lincoln was supplied with the electric light for the first time on Wednesday evening. This week the City Council are applying to the Local Government Board for power to borrow a further sum of £19,000 to extend the cables to other parts of the city.

Maidenhead.—Messrs. Burstall & Monkhouse's report and estimates *re* electric lighting are in the hands of the Town Council, who will shortly consider the matter.

Manchester.—The Manchester papers say that owing to an explosion in the neighbourhood of St. Peter's Church, there was an interruption of the supply of the electric light on Sunday. The arc lamps in Albert Square and other lights were temporarily extinguished.

Marylebone.—On Monday, at the Board of Guardians, the Workhouse Committee recommended that advertisements be inserted inviting tenders for the electric lighting of the front blocks. The architect estimated that the cost would be £1,200. The recommendation merely refers to wiring and fittings; the question of current supply will be decided later. The resolution was carried.

Middlesbrough.—At last week's meeting of the Electric Lighting Committee a letter was read from the Board of Trade approving of the scheme recommended by Mr. Hammond for the electric lighting of the borough. In response to the advertisement for tenders for plant 62 were received. Mr. Hammond said his estimated cost for this part of the work was £22,438, and the most acceptable tender sent in amounted to £21,967, or £460 below his estimate. It was decided to refer the tenders to a sub-committee to report upon to the next meeting.

Middlesex.—The Middlesex C.C. have resolved to oppose the provisional orders now being applied for by Twickenham, Finchley, and Hendon. A similar resolution with regard to light railways has also been arrived at, the intention being in both cases to get a *locus standi*.

Morecambe.—At a recent District Council meeting it was stated that the Electric Lighting Committee were going in for steam turbines. It was resolved to accept the following tender for extensions of plant:—For section A, Thomas Parker, Limited, £484; B, C. A. Parsons, £245; C, C. A. Parsons, £2,280; D, Thomas Parker, Limited, £486; E, Thomas Parker, Limited, £985; total, £4,480. The Council is considering the question of free wiring.

Moss Side.—At the last meeting of the District Council, the clerk said that he had received a reply from the Manchester Corporation, expressing the regret of the Electric Light Committee at the delay which, from causes over which they had no control, had occurred in connection with the installation of the electric light in the district of Moss Side. The Corporation had not yet received the sanction of the Local Government Board for the borrowing of the necessary money. The letter also added that the committee would take immediate steps for proceeding with the work.

Newport.—The office manager's monthly report shows that his canvass during the past month has brought orders for the equivalent of 820 8-C.P. lamps, bringing the total number of lights connected and on order up to the equivalent of 21,425. From 800 to 1,000 lights will be required at the new hospital on Cardiff Road. The borough electrical engineer has reported that the emergency plant will be ready for running on the load in the course of a week or so. The capacity of the plant, exclusive of the reserve, is 300 kilowatts. The highest load yet reached was attained during the past month, viz., 330 kilowatts. The Westminster and Union Insurance Offices had agreed to accept the insurance of the electric light station, including the extensions, at 5s. per cent. The total amount of the insurance proposed at present is £27,500. Mr. Stephen Taylor, of Llanarth Street, has complained of alleged damage caused to him and his business by the noise from the electricity works, and his solicitors have asked what the Committee were prepared to do in the matter. Instructions were given to the town clerk to defend any action which may be taken, and the chairman and vice-chairman have been authorised to take certain steps in the matter. A later meeting of the Electricity Committee had before it the matter of the Brighton charging system, and it was resolved that the question of adopting the suggested method of charging be deferred for a period of 12 months, and that in the meantime demand indicators be fixed upon the premises of a few consenting consumers as an experiment; the system of charging in respect of such premises to remain unaltered during the experimental period.

Newton Abbot.—At last week's meeting of the District Council the Lighting Committee presented their report on the proposed electric lighting installation by Edmundson's Corporation. A sub-committee had been appointed, and Mr. Hancock had advised the Council on the matter. A series of clauses had been drawn up for submission to Edmundson's Corporation, who were applying for a provisional order to carry out the undertaking. These clauses provided that the undertaking should not go beyond the Council's district, and referred to the question of charges, purchase of undertaking, &c. The adoption of the report was agreed to.

North London Electricity Company.—The large scheme which was proposed by this company for the supply of electricity in a number of North London districts has been withdrawn for the present. The company has lately notified the Edmonton, Southgate, Enfield, and other authorities to this effect.

Norwich.—We understand that on Friday last considerable inconvenience was caused at the post office, hotel, and other establishments through the failure of the electric light.

The directors of the Electric Light Company are asking consumers not to use more light than is necessary during the Christmas season owing to the very heavy demand upon their plant and mains.

Oldham.—The Electric Light Committee last week visited a number of sites for the purpose of selecting one for electric light and tramway power station. Prof. Kennedy will shortly visit the town and go into a scheme.

Paddington.—On Tuesday at the meeting of the Vestry the Electric Lighting Committee reported as follows: "That this Committee, having considered the letter from the Metropolitan Electric Supply Company of the 8th ult., are of opinion that unless the Vestry are prepared to purchase the Paddington undertaking of the company, no advantage can be obtained from further communicating with the company on the subject; but your Committee, at the same time, are fully aware that the Vestry might find it difficult to say whether they will buy or not until the probable terms of sale are made known to them. Under these circumstances your Committee solicit further and definite instructions as to the wishes of the Vestry." After discussion, Sir George Fardell moved that the Vestry are not prepared to give any further instructions, the reference being left in the hands of the Committee for them to report thereon or otherwise, as they may decide. This, having been seconded, was carried. Sir George Fardell then moved that with regard to the electrical energy, &c., recommendation of the Committee, to add: "That a letter be addressed to the Metropolitan Electric Supply Company, asking them when they propose to fulfil their obligations under the provisional order of 1890; and further, the attention of the London County Council be called to the fact that no testing facilities have been provided." A member moved an amendment:—"That inasmuch as the Metropolitan Electric Supply Company have failed to perform their obligations the Electric Lighting Committee be authorised to take any steps they may deem advisable to obtain a provisional order. On a vote being taken, the amendment was lost. Sir George Fardell's resolution was carried.

Partick.—The agreement entered into between the Glasgow Corporation and the Partick authorities for the supply of electricity to the burgh provides that the Corporation shall repay to the Commissioners the costs incurred in respect of the provisional order. The prices charged are to be the same to private consumers as in the city, while that for public lamps is to be settled by agreement. If the Corporation any year exercise their option of applying any of the surplus revenue to the improvement of the city, a proportionate amount is to be paid to Partick, to be applied to like purposes in that district. A similar arrangement is made as to deficits.

Perth.—The Electric Lighting Committee recently prepared a circular for sending to various companies requesting them to state the conditions on which they would be prepared to lease the order. The Police Commission has been communicating with Mr. Hawtayne on the question of terms upon which he would act as advising engineer if the Council resolved to lease the provisional order to a company. Mr. Hawtayne replied that he understood that the question had been arranged before, and that they were to amount to 5 per cent. on the contract value of the works, whether the powers were leased to a company or carried out by the Commissioners themselves. The Council has resolved to pay Mr. Hawtayne's account up to date, and to inform him "that he had not as yet been appointed engineer for the scheme, further than that they now agreed to issue forms of tender and specifications to the companies as recommended."

Plymouth.—At the last Council meeting Alderman Radford, in presenting the report of the Electric Lighting Committee, said that he quite anticipated that the electricity works buildings would be complete by March or April next, and the installation in full working order. In reply to a question as to whether the rumour that he had under-estimated the work to the extent of £10,000 was correct, the borough electrical engineer, Mr. Rider, said that on the plant there was no excess, but in the building operations there had been a considerable increase in the cost, amounting perhaps to £10,000, for which he was responsible. The full estimate was £46,000.

Portmadoc.—A member of the Urban Council is bringing the question of electric lighting before that body.

Portsmouth.—At a Town Council meeting last week the Electric Lighting Committee recommended that application be made to the Local Government Board for sanction to borrow £18,000, being a further portion of £40,000 which was previously sanctioned by the Council for the purpose of additional machinery and plant at the electric light station. Alderman G. Ellis, J.P. (chairman of the Committee), in moving the adoption of the report, said he was happy to be able to tell the Council that the estimated number of lamps they expected would be put up by the end of the year had been exceeded, and the demand was so heavy that the staff was unable to meet it. They had already 20,000 lights on the engines fixed in 1897 for 30,000 lights. In 1897 it was suggested to the contractor that he should book them an engine for 1899 if he would supply it at the same price. The contractor had agreed to supply them with a new engine at the price of the last one. Mr. Ellis added that he had no doubt the Committee would show a considerable and handsome balance at the end of the year. The Committee's recommendation was adopted.

Saw-mill Lighting.—Messrs. Jewson & Sons have installed the electric light at their Southtown saw-mills and yards, and on Wednesday last week it was used for the first time.

Rhyl.—Mr. J. L. Owen, in his report *re* an electric lighting scheme, puts the estimated cost of an installation for Rhyl at £16,679.

Rothesay.—The Electric Lighting Committee recently asked the Council to agree to their inviting offers for the scheme recommended by Mr. T. C. Fulton, the engineer, at a cost of about £6,500. After a prolonged discussion, the Council adopted an amendment asking for further information.

Ryde.—The Town Council is opposing the application of the Ryde Electric Light and Power Company for a provisional order.

Santiago.—According to *Sell's Commercial Intelligence*, a syndicate of English and German capitalists is to take charge of the electric lighting and railways of Santiago. Power will be taken from the Maipo river. Something like a million and a quarter sterling is invested in the enterprise, and work has commenced. Purchases for the undertaking will be made in England, Germany, and the United States at an early date.

Shoreditch.—The Lighting Committee informed the Vestry at a meeting on Tuesday, that they had considered reports from Dr. Mansfield Robinson, vestry clerk, and from Mr. Newton Russell, chief electrical engineer, on the subject of acquiring a site for the building of a new generating station. As a result, the Committee submitted the following recommendations:—(1) That it is desirable that an additional site should be acquired by the Vestry, of sufficient size, and in such a situation in regard to railway or canal accommodation as to be suitable for meeting the increasing demands of this parish for electric light and power; (2) that the vestry clerk be instructed to approach the Ironmongers' Company with a view to the purchase by the Vestry of their property, known as the Ironmongers' Almshouses; (3) that a specification be prepared by Messrs. Kincaid, Waller & Manville, under the terms of their letter of January 10th last, in conjunction with the chief electrical engineer, with a view to obtaining tenders for two 750-kilowatt sets of engines and dynamos, with necessary boilers and switch gear, &c., in preparation for the new station. When the question came up for discussion the Vestry resolved itself into committee, and considered the recommendations in private, although the secrecy appeared to solely surround the second proposal made by the Committee.

Slough.—The District Council has resolved that an electrical engineer be employed to prepare a full report on electric lighting.

Southampton.—The electrical engineer has reported to the Committee of the Town Council having charge of the electrical works that the number of units sold during November was 31,580, an increase of 30 per cent. over the number sold during the corresponding month of the previous year.

Stirling.—The National Electric Free Wiring Company is conferring with a sub-committee *re* electric wiring.

Sunderland.—The Guardians' House Committee is considering the cost of lighting the new infirmary at the workhouse by electricity.

Surbiton.—After communicating with the District Council *re* its provisional order, the Board of Trade has resolved to defer the consideration of the question of revocation for a year.

West Ham.—At last week's Town Council meeting a long report by the electrical engineer was brought up by the Highways Committee. Mr. Steinitz, in the first place, pointed out that the heaviest part of the load was in Woodgrange Road, at the extreme end of the feeders. To enable the department to keep the pressure there within the Board of Trade limits he proposed to lay a feeder from the central station to the Upton Lane chamber. The committee recommended that the proposal be approved, and that the route be *vid* Stephen's Road, Plaistow Road, Grafton Road (north), Terrace Road, Stopford Road, and Upton Lane; also, that on the portions of such route suggested by the electrical engineer, the cables be laid in earthenware pipes and a spare line of pipes laid to avoid the necessity for subsequent frequent openings of the road. The cost of this work, estimated by the electrical engineer at £3,000, will be covered by the loan already sanctioned. The electrical engineer made a number of important suggestions for extending the present lighting scheme. The committee recommended that the extensions recommended by the electrical engineer be approved; also in connection therewith that the mains be laid in High Street from Stratford Bridge to the borough boundary at Bow Bridge. The total cost of the whole of these extensions is estimated by the electrical engineer at £51,000. Having regard to the special character of the plant to be provided, they recommend the Council not to advertise the various contracts, and having carefully considered the difficulties which have arisen in starting the present plant, the suggestion in the electrical engineer's report, with regard to obtaining the engines and alternators from separate makers, be adopted, and the Council approve of the combination of McLaren's engines and Ferranti's alternators, providing satisfactory tenders can be obtained from the firms named on specifications to the satisfaction of the electrical engineer. Babcock and Wilcox's tubular boilers to be used, providing satisfactory quotations can be obtained. Messrs. Ferranti are to be instructed to carry out the extension of the switchboard, subject to their tender being satisfactory. The contract for the additional cables to be given to the British Insulated Wire Company, at the prices at which they supplied the cables already laid. The new mains to be laid by the Council's own workmen, under the direction of the electrical engineer. The Brush Company's transformers to be again adopted, subject to a satisfactory contract, and the transformer chambers constructed by the Council's own workmen. The recommendations were adopted. The electrical engineer also reported:—"The expenses in connection with the central electric light station, from September 29th, will naturally be charged against our revenue, when we have one. This would be distinctly unfair to the department, as it is entirely owing to Messrs. Ferranti that we have not been earning a revenue, at least sufficient to cover these charges. I think, therefore, it would be well if you instructed me to write to Messrs. Ferranti, informing them that we propose to deduct all our men's time, the cost of all the oil, coal, water, &c., from their contract price." This was agreed to, on the recommendation of the Committee.

Westminster.—The Works and General Purposes Committee of the Westminster Vestry recently reported the receipt of a letter from the Westminster Electric Supply Corporation, Limited, making proposals for public lighting in the parish. A report has been presented by the surveyor, who is of opinion that the Vestry should not delay in securing to themselves a sufficient plant, &c., for the purpose of generating electricity for lighting and other matters, and they should be cautious in entering upon any undertaking which will hamper them in the near future should this policy be adopted. The Vestry decided on the committee's recommendation that they are unable to entertain any one of the proposals in their present form.

Whitechapel.—The District Board on Monday appointed Mr. Arthur Wright, electrical engineer to the Brighton Corporation, engineer to the Board for five years, at a salary of £600 per annum, to carry out the electric lighting of Whitechapel.

Wigan.—The Council, after considering the report of a deputation which has visited Bradford, Leeds, and Wakefield, has decided to engage a resident electrician to prepare plans and specifications for the carrying out of the electric light and electric traction installation. It is the intention of the authority to push the matter on as speedily as possible.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Bangor.—The Town Commissioners on 13th inst. had a discussion *re* the projected tramline from Bangor to Donaghadee. Some speakers suggested that if electricity is employed, the trolley should be prohibited for the town, but not for the country roads.

Bristol.—The more conciliatory attitude assumed by the tramway company at Bristol has borne such fruit, that the difficulty which threatened only a few weeks ago to end in legal proceedings has been practically settled. The trouble occurred over differing opinions as to the mode in which trolley wires should be carried. The Sanitary Committee disliked span wires, except where they could be strained between the houses, so as not to need poles, and desired centre poles in wide streets, and side poles with bracket arms in narrow ones. The company declared this would mean considerable deviation from their scheme as sanctioned by Parliament, but ultimately asked that the city engineer might meet their officials and talk over matters. That conference has taken place, and those taking part in it appear to have gone over the long list of streets affected by the tramway company's scheme of electric traction, so that each might be dealt with on its merits. The result of this friendly meeting was reported to the Sanitary Committee in a detailed statement, from which it was evident that the company had met the committee's views in many directions, while in others the committee was asked to meet the company's wishes. The city engineer, in general comments on this outcome of the conference, said he believed the arrangement fairly represented the views of the committee, as far as they were consistent with the practical working of the Act giving powers to the company to make their tramways, and equip them with electrical power. He recommended, therefore, the provisional arrangement be confirmed. This course was not deemed altogether satisfactory by one or two members. Mr. Lloyd reminded the committee that they had decided they would not have span wires at all, and he moved that the position of affairs be reported to the Council, and

that body be asked for instructions. The vice-chairman, Mr. George Pearson (who happens to be chairman of the Electrical Committee, and who has taken a leading part in the tramway controversy), agreed with Mr. Lloyd, but said it was useless to go to the Council, for the Council would only support the tramway company. After this prophetic utterance no one was found to second Mr. Lloyd, and the committee (subject to one or two alterations in not very important details) agreed to the provisional settlement arrived at by their engineer.

Doncaster.—At a special meeting of the Council last week a resolution was carried confirming the application which is being made to the Light Railway Commissioners for an order authorising the Corporation to establish and work a light railway in the borough of Doncaster, and to Balby and Hexthorpe, within the Urban District Council of Balby-with-Hexthorpe; to Bentley, within the parish of Bentley-with-Arksey; and to Wheatley. In moving the adoption of the resolution, the Mayor said that they were very much encouraged by the way in which their proposals had been received by the neighbouring authorities—the District Council of Balby-with-Hexthorpe, and the Parish Councils of Wheatley and Bentley-with-Arksey. These had expressed their approval of light railways being established by the Corporation in preference to being worked by a company. They had it on the authority of their electrical engineer, Mr. Shoolbred, and Mr. Preece, that where local authorities were proposing to light their towns with the electric light it was very desirable that they should have full control, so that power should be available at day time for working the trams when not required for lighting purposes.

Dublin.—The Dublin United Tramways Company has "kindly consented to the disuse of trailer cars generally," with the exception of special occasions when an arrangement will be made with the borough surveyor.

Dudley and Stourbridge.—The British Thomson-Houston Company has received a further order for a 100-kw. generating set, together with the necessary switching gear, &c., for the above electric tramways.

Dundee.—Plans, &c., are in preparation for the Council in connection with the extension of the electric lighting works for the purpose of supplying power for the tramways when taken over. The plans and estimates of all that is in contemplation will be placed before the Tramways Committee shortly.

Edinburgh.—Owing to the "difficulty that has arisen regarding the cabling of the suburban tramway line between Edinburgh and Portobello, due, amongst other things, to the narrowness of portions of Portobello High Street," the Simplex Conduit Electric Traction Syndicate, of Liverpool, has written to the Town Council explaining its system, and suggesting that it would be a comparatively simple matter to convert the cable conduit already laid, to the use of electric traction by the addition of the necessary wire, insulators, and other equipment. The letter is dated November 16th, but has not yet been placed before the Council.

The Town Council last week remitted a motion to the Lord Provost's Committee to consider and report as to the desirableness of working the Portobello section of the tramways with electrical power.

Gillingham.—Last week a special meeting of the Council was held to consider the draft order authorising the construction of light railways in Gillingham and Chatham.

Glasgow.—Last week the Council approved of the minutes of the Tramway Committee, which stated that after considering the memorandum by the general manager on electric traction it was agreed by 15 to 2 to have the Govanhill route and connecting line to Coplawhill equipped for overhead traction, and that a report be prepared as to the practicability and cost of equipping a suitable route for the conduit system. An amendment which was lost was to the effect that a portion or the whole of the Govanhill route be equipped as a demonstration of the conduit system.

Hastings.—On 15th inst., a large meeting of townspeople was held to decide whether the town should have electric trams or not. A large majority voted for them. A poll of the town is to be taken. The Council has appointed a sub-committee to inspect various tramway systems in the United Kingdom.

Kingston.—At a meeting of the Town Council on Tuesday, it was reported that the Corporation had been approached by a syndicate who proposed in the ensuing session of Parliament to apply under the Light Railway Act for an order incorporating the Kingston District Traction Company, with powers to such company to construct lines, works, &c., for the purpose of establishing electric traction (trolley) along certain roads of the town and district. It is suggested to take current from the borough electric light works. The capital of the company is to be about £100,000. A committee of the Council are considering the proposals.

Liverpool.—Referring to the progress of the Dingle electric tramway, Mr. Rutherford, chairman of the Tramways Committee, told the Council last week that as to receipts, the fares for 23 days on the electric system amounted to £1,886, being £813 from the motor cars and £1,072 from the trailers. The passengers during a period of 17 days were as follows—188,797 in the 1d. cars and 77,083 in the 2d. cars, the large total showing that the service had been highly appreciated.

Middleton (Manchester).—The Parliamentary proceedings sub-committee of the Manchester Corporation have approved of the minutes containing an intimation from the secretary of the British Electric Traction Company, Limited, of the intention of the company to make application to the Light Railway Commissioners for an order authorising the construction and working of a light railway between Middleton and Crumpsall.

Perth.—With reference to the proposal of the Perth and District Tramways Company to convert their tramways from horse to electricity, the Police Commission has delayed consideration for the present.

Portsdown and Horndean.—On Monday morning the consideration of objections to the proposed Portsdown and Horndean Light Railway came before Sir Courtenay Boyle, Permanent Secretary of the Board of Trade. Powers are sought under the order asked for to construct a light railway from Cosham in connection with the Portsmouth Tramways, running for six miles north to Horndean, on the Portsdown Hill. The Portsmouth Tramways Company are the promoters. On behalf of the London and South-Western Railway Mr. Balfour Browne said he did not propose to object to the scheme, as he very well might have done on the ground of its competition with the goods and passenger traffic of the South-Western between Horndean and Portsmouth. The proposed line, however, would have a level crossing, authorised in 1845, over the South-Western between Fareham and Portsmouth, on the public road. It was proposed to work the new line by electricity, and this would add to the difficulties and dangers already existing at the level crossing. All the electric signals of the railway at the present time were worked on what was popularly known as the earth return system, but, as a matter of fact, the electric current returned along the rails. Counsel contended that a stray 10-volt current of the light railway might alter the signals at the level crossing worked by a 2-volt current and cause a serious accident. He suggested that the proposers should be required to construct a bridge over the South-Western for the purposes of the light railway. Mr. Charles J. Owen, general manager of the London and South-Western Railway Company, said the cost of the suggested bridge would be between £3,000 and £4,000. There was no hardship in asking the promoters to construct a bridge over the line. Sir Courtenay Boyle, having heard the arguments for the promoters, said he could not at once say what he should recommend to the Board of Trade on the point raised.

Sheffield.—Profiting by the experience of Bradford, the Sheffield Tramways Committee has been seriously considering the question of brakes in order to minimise the difficulties of steep gradients and curves occurring on the Walkley electric line. In addition to the ordinary brakes, there will be slipper brakes employed, and these are considered sufficient to overcome all difficulties.

Southend.—It has been decided to carry out alterations and improvements upon the Pier electric tramway at an estimated cost of £427.

Southport.—At a recent meeting of the Council, in moving the adoption of the Tramways Committee's report, Councillor Travis stated that a provisional order was being applied for by the British Electric Traction Company for power to lay down lines along the route which the Corporation themselves intended to use for that purpose. The Southport Tramways Company had also given notice of a Bill to enable them to generate electricity and work the trams by electric traction. The lines used by the company were the property of the Corporation. He might inform them, however, that the General Purposes Committee and the Parliamentary Committee would shortly meet with a view to a petition being lodged against the Bill of the Southport Tramways Company, and to consider a statement of objections of the Electric Traction Company. It was agreed not to oppose the Bill promoted by Mr. Wood, civil engineer, of Liverpool, for power to carry out a scheme for connecting Southport with Lytham by means of a tramway.

Stretford.—The District Council, at their last meeting, passed a resolution in favour of the promotion of a Bill in the next Session of Parliament to enable the Council to work the tramways in their own, or any adjoining district, by animal, mechanical, or electrical power, and also to acquire running powers or leases in adjoining districts.

Withington.—The Urban District Council, having reconsidered the subject of arranging with the Manchester Corporation to take the control of the tramway system in the neighbourhood, have unanimously decided to seek powers to acquire, equip, and work the tramways in their own district.

Wolverhampton.—A meeting of owners and ratepayers on Monday carried unanimously a resolution sanctioning the Corporation Tramway Bill.

Yarmouth.—The Yarmouth and Gorleston Tramway Company recently wrote asking the Corporation to supply current for traction purposes on the basis of 2d. per unit up to 150,000 units, at 1½d. between that limit and 200,000 units, and exceeding 200,000 units at 1¼d. per unit; and also asking that the time within which the tramways became purchaseable should be extended to 21 years, making 27 years from the present time. The Lands Committee recommended the Council not to entertain the application. When the matter came before the Council last week, an amendment referring it back to Committee was negatived.

ELECTRIC TRAMWAYS AND LIGHTING AT CORK.

THE distinctive feature of the recently completed works at Cork is the combination of lighting and tramways. The following details of the scheme have been furnished by the chief contractors, the British Thomson-Houston Company.

The plant comprises three Babcock & Wilcox boilers, each having 2,531 square feet of heating surface, capable of evaporating 8,000 lbs. of water per hour, the normal working pressure being 150 lbs. A somewhat novel form of chimney stack is employed. It is of steel, and although 130 feet high, is self-supporting. It is 7 feet internal diameter, and lined with 4½-inch fire-brick, and is erected on piled concrete foundations.

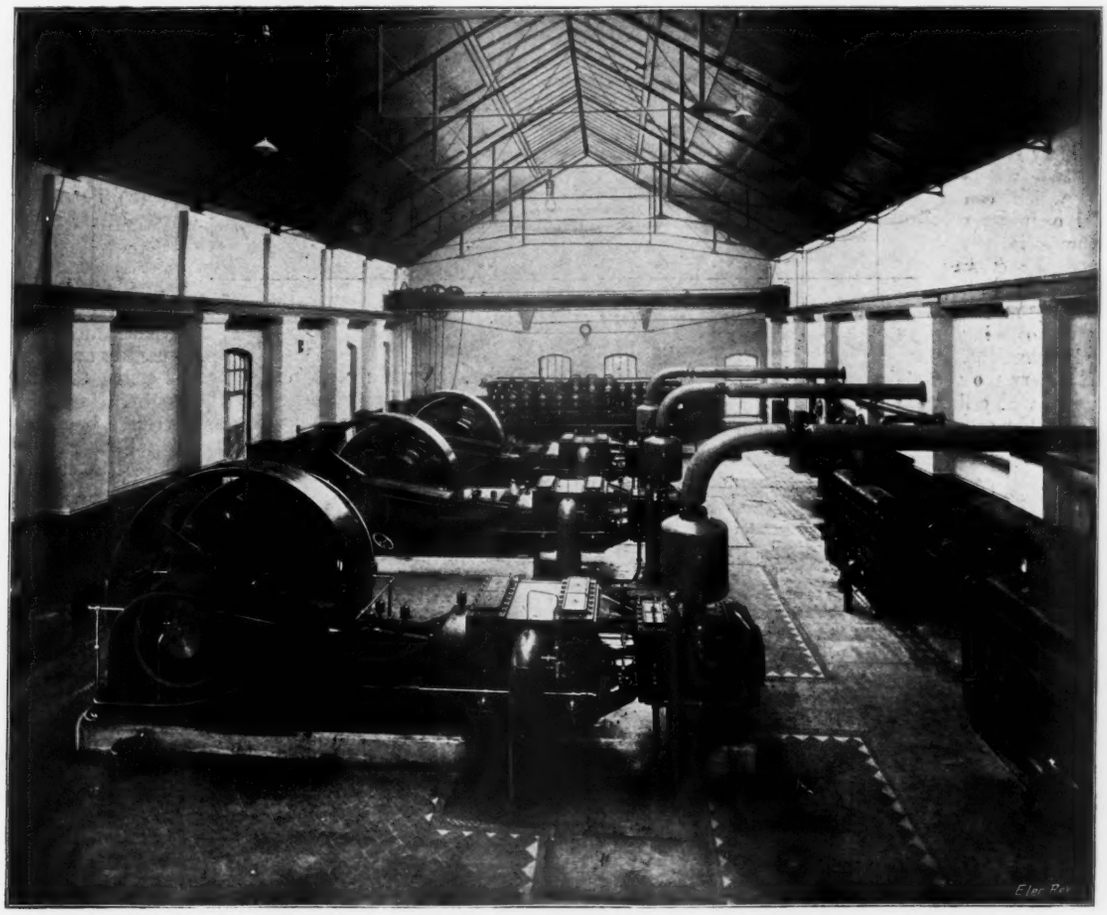
A feed heater of the Wheeler Condenser and Engineering Company utilises the exhaust of the feed and condenser pumps. Blake & Knowles feed pumps are employed. They are arranged compound, the diameter of high pressure cylinder being 6 inches, low pressure cylinder, 9 inches, water cylinder 4 inches in diameter, with 8-inch stroke. The steam cylinders of these pumps are fitted with an improved outside valve gear, so that they can be adjusted full length of stroke under all conditions of speed. The steam connections of the pumps are so arranged that, in case of any repairs being required, either pump can be worked independent of the other.

The hot well is situated in the boiler house, and is fitted with baffle plates, the divisions in which can be filled with coke and straw, if desired, for the purpose of intercepting any oil that may be discharged into it. It is fitted with suitable outlets, so arranged that by opening a valve and filling the tank, the oil, which will be found floating on the surface, can be run off.

The feed water, before entering the boiler, can be passed through two Edmiston filters, capable of filtering 16,000 lbs. of water per hour. These filters are arranged on a twin system, fitted with the necessary valves to enable the filters to be used on either range of feed pipes.

The steam piping is of steel, fitted with heavy screwed steel flanges, so arranged that any engine can be fed direct from the boiler immediately behind it. The necessary valves are inserted to enable any faulty section in the piping being cut out. This piping is fitted with an automatic atmospheric valve, which, in the event of there being any pressure due to the failure of the condensing plant, will immediately allow the engines to exhaust direct into the atmosphere. The piping on the atmospheric side of this valve is of thin steel, riveted together in spirals.

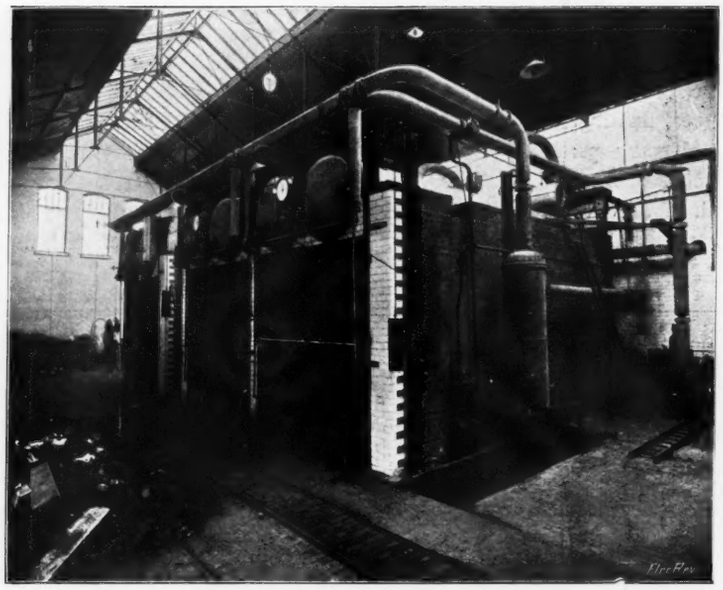
In the engine room are three McIntosh & Seymour side-crank tandem compound condensing engines, running at 135 revolutions per minute. They are fitted with expansion governors; there being separate exhaust valves on both high and low pressure cylinders. The high pressure cylinder is



GENERAL VIEW OF POWER HOUSE.

steam jacketted and exhausts into a receiver, in the interior of which are fixed three copper coils, which can be heated with live steam. These engines are coupled direct to 6-pole 200-kilowatt compound - wound generators, giving 500 volts at 135 revolutions.

There are two Wheeler Admiralty type condensers, the engines being in the centre, an air-pump at one end, the circulating water pump being at the other end. Each combination is capable of dealing with 12,000 lbs. of steam per hour. Water is taken direct from the river through 12-inch cast-iron pipes, there being an auxiliary supply from the waterworks, which can be laid on to start the pumps in the event of the suction pipe being emptied, through the retaining valve not being perfectly watertight.



View of Boilers.

The battery room contains 256 Tudor cells, mounted in three tiers, each cell containing six positive and seven negative plates, the capacity of the battery being 770 ampere-hours, the normal rate of discharge 110 amperes, and the maximum rate 210. The battery stands are of pitch pine, coated with acid proof paint, and mounted on large oil insulators. This battery can be charged either from traction or lighting bus bars as desired, the necessary volts for charging being supplied by a booster, which can also be driven from the traction or lighting bus bars. The switchboard is at the end of the engine room, and contains :—

(1) Three generator panels, fitted with automatic circuit breakers, with magnetic blow-outs, as well as the necessary switches, so arranged that the generators can be connected direct to either the lighting or traction bus bars.

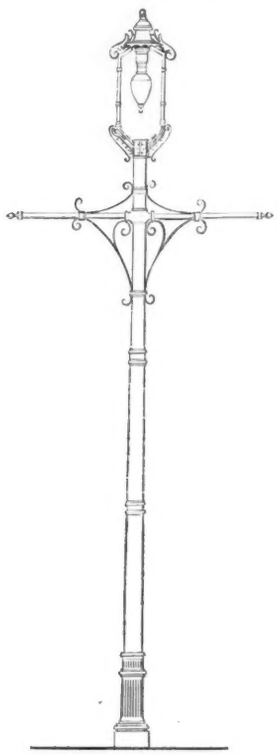
(2) Two battery panels, fitted with necessary regulating switches and magnetic blow-outs, and arranged so that the battery can be either charged from, or discharged on to either the lighting or traction circuits as desired.

(3) Two balancer panels, arranged so that the balancer can, if desired, in the daytime, be driven direct from the traction bars, or used as an ordinary balancer, the two motors being in series across the outers, the junction being connected to the neutral; in this case, the set being run up to give its correct voltage by means of the motor placed in the centre, the electrical connections to which are disconnected after the balancer sets are connected to the network.

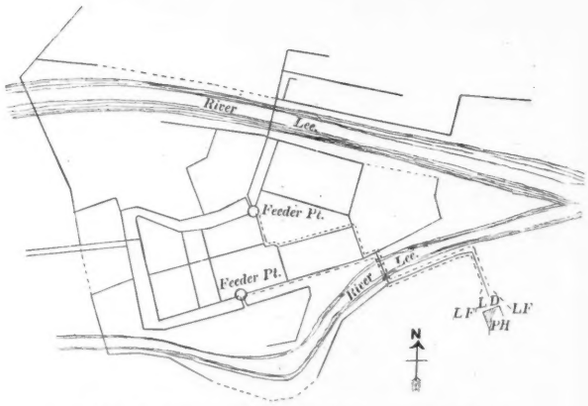
The switchboard is also fitted with a panel containing the necessary instruments required by the Board of Trade for purposes of testing.

The lighting distribution is on the three-wire system, with 460 volts between the outers, the mains being all of Messrs. Callender's manufacture, and in the majority of cases consisting of jute covered, lead sheathed, tape armoured cables, laid direct in the streets.

Altogether over 20 miles of cable (lighting and traction systems) have been laid; the distance between the feeding points (of which there are two at present) and the station being just under half a mile. In their course from the power station to the feeding points, the cables cross the River Lee, and as there is only a swing bridge at this location, the cables had to be laid in a trench excavated in the bed of the river; Callender's vulcanised bitumen wire armoured cable being adopted as most suitable for the purpose. Four addi-



Arc Lamp, Arms Carrying Trolley Wires.

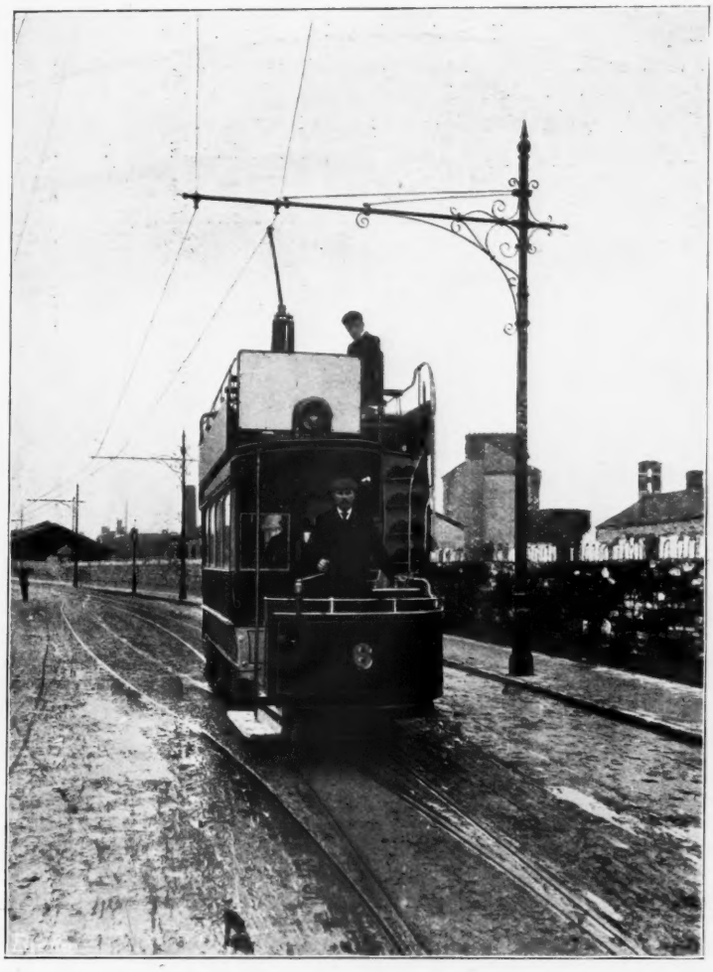


L F, Lighting feeders; L D, Lighting distributors; P H, Powerhouse.

Plan of Lighting Network.

tional spare feeder cables, each of ·7 inch sectional area, have been laid across the river to cope with future extensions; the vulcanised bitumen cables being brought together in a pit on each side of the water, where they are connected to the ordinary jute covered, tape armoured cable laid in the streets.

The greater proportion of the distributing cables in the centre of the city are of the three-core type; the largest distributor used having a sectional area of ·15 inch. In all the outlying districts, three single distributing cables are used, and, in addition to their armouring, they are further protected by a covering layer of bricks. At the crossing and junction points of the network, Callender's disconnecting boxes are fixed, and, of these, 19 are at present installed.



Car on Line.

Reverting more particularly to the tramway system, it may be said to follow the main streets in the centre of the city, which is on an island formed by two branches of the River Lee.

In the city proper a double track is laid, branch lines passing to Tivoli, St. Luke's, Western Road, Blackpool, and Douglas. The longest section is to Douglas, a village about two miles south of Cork.

The tramway crosses the river twice, first over Parnell Bridge, a steel swing bridge; second over Patrick's Bridge, built of stone.

The rails in the city are laid on a bed of concrete, the roadway being paved between the rails and 18 inches outside rails. Outside city boundaries the rails are laid on creosoted sleepers, 6 feet by 4½ inches by 9 inches. The rails are of girder type, weighing 83 lbs. per yard; the fish-plates being of steel, 26 inches long and weighing 56 lbs. per pair. The tie-bars are of wrought-iron, 2 inches by ⅜ inch, weighing 10½ lbs., double screwed at ends. The rails are fixed to the sleepers by 30 dog spikes and 14 fang bolts and chips to each rail length, the points being of cast-steel, made by Millar & Co. and Dick, Kerr & Co., Limited. The crossings are built up as the work proceeds.

The rails form the return circuit and are electrically connected at each straight joint by two No. 000 B. and S. Chicago bonds 35 inches long; at every point there are two 13-feet bonds spanning the steel casting, and there are also for each point four 35-inch bonds, arranged as shown in the illustration. At each crossing there are four No. 000 B. and S. 35-inch bonds. The rails are cross bonded for every 240 feet, and where double track, the tracks are also cross bonded in every 240 feet. These track cross bonds are placed half way between the rail cross bonds.

Where double track with central poles are employed, the cross bonds between the two tracks are 7 feet long, and where double track with side poles 5 feet long. All the cross bonds on single track are 42 inches. In all the loops on the single line there is a cross bond between the two tracks.

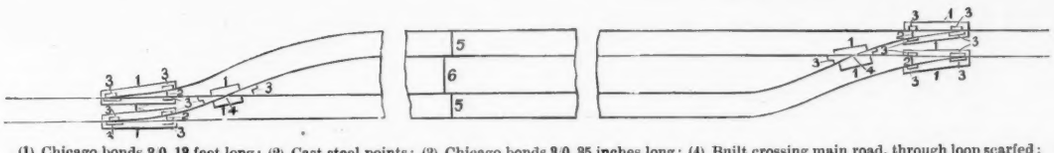
The return circuit is continued over the river at Parnell Bridge by four ·5-inch cables, connected by bonds to the rails on either side of the water, this arrangement being necessary to avoid any interruption in the circuit when the bridge is swung open.

The overhead construction consists of centre poles with double-bracket arms in the principal streets, and on the remainder of the line. Side poles with single-bracket arms are used, span wires being employed in only a few places. The poles are 31 feet long, composed of three sections, the joints overlapping, and shrunk on while hot.

In the principal streets an arc lamp is fixed on every alternate pole. The lamps are of the enclosed arc type, connected up 5 in series; they are also connected so that the consecutive lamps are on different circuits.

The switches and resistances are contained in the bases of the poles, so that a resistance can be placed in the circuit instead of a lamp, if necessary; also, each circuit can be controlled from any lamp in its circuit.

The trolley wire is of hard-drawn copper, and double throughout. The portion of the trolley wire over the swing part of Parnell Bridge is supported on special poles and brackets fastened to movable parts of the bridge; the con-



(1) Chicago bonds 3/0, 13 feet long; (2) Cast-steel points; (3) Chicago bonds 3/0, 35 inches long; (4) Built crossing main road, through loop scarfed; (5) Chicago bonds 3/0, 42 inches long; (6) Chicago bonds 3/0, 5 feet long.

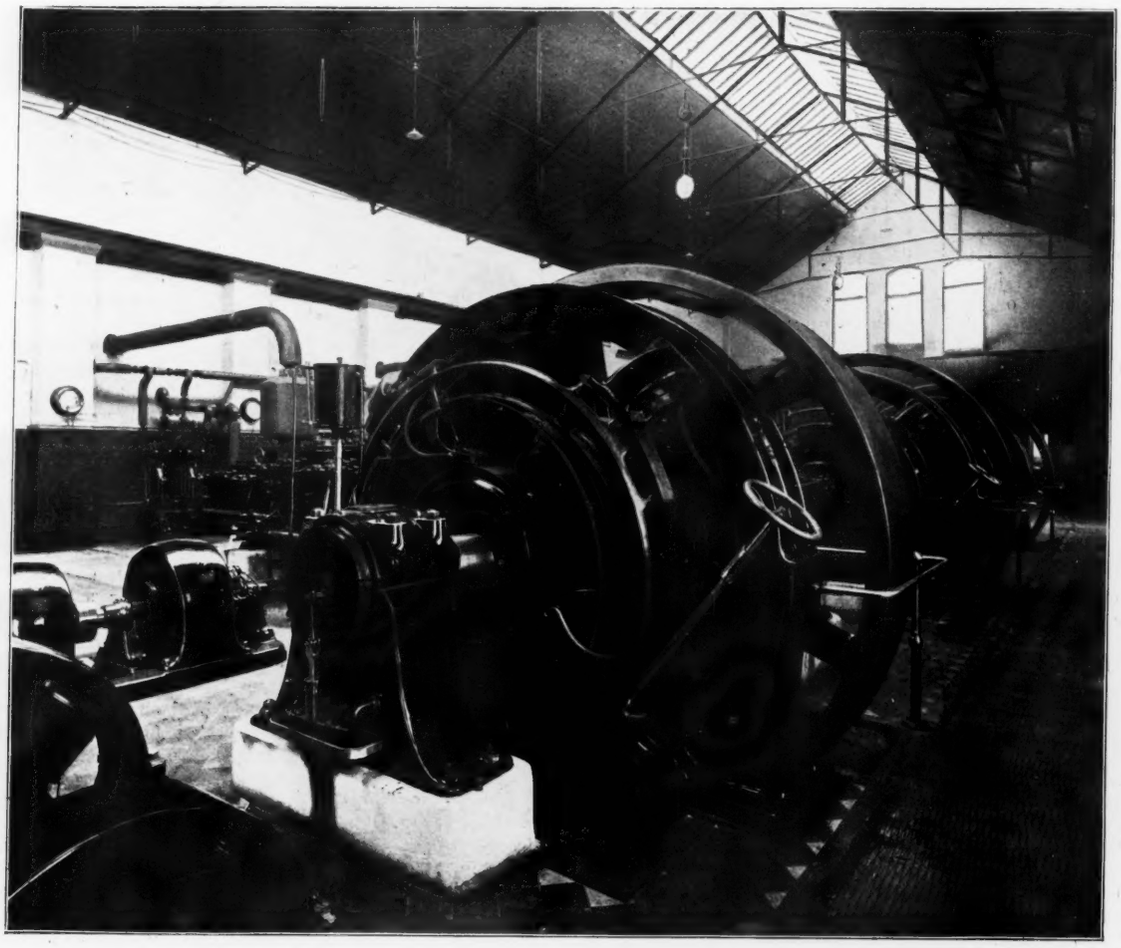
Method of Bonding.

nections on the trolley wire being heavy spring clips, which allow the bridge to be moved in either direction.

At the present moment there are 18 top seat cars, capable of seating 44 passengers. These have been manufactured by the Brush Electrical Engineering Company, Limited, and are mounted on single Peckham trucks; the motor equipment

Present customers stand as follows:—

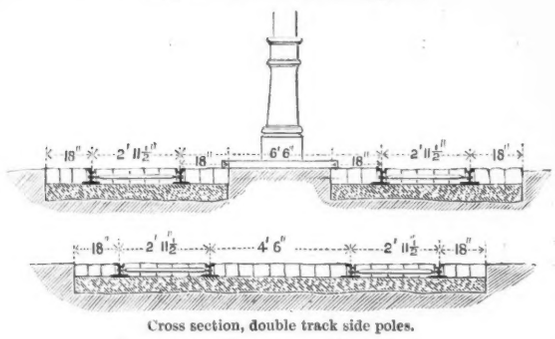
Number of customers who have applied ...	217
Lamps applied for	11,622
Motors applied for	18
Total horse-power	113
Total applied for in 8-C.P. equivalents... ...	14,447



VIEW OF GENERATORS.

consists of two G.E. 60 motors with series parallel controllers; the motors being specially designed for this work on account of the very narrow gauge, namely, 2 feet 11½ inches; in other

Cross section double track centre poles.



Cross section, double track side poles.

DETAILS OF CENTRE AND SIDE POLES.

respects the car equipment follows the standard practice of the B.T.H. Company.

The supply of current for light, &c., was started about the beginning of September, and since then about 130 customers have been connected to the mains.

When the public arc lighting is permanently arranged, there will be altogether about 100 lamps.

The tariff for light is 5d. per unit for the first two hours, and 1d. afterwards, on the Brighton system of charging.

The present tariff for motive power is 4¼d. per unit for the first hour, and 1d. afterwards.

The British Thomson-Houston Company, Limited, were the contractors to the Cork Electric Tramways and Lighting Company, Limited, for the work as a whole—construction, building, machinery, &c., in connection with the system, and themselves supplied complete electrical equipments of the power station and cars.

The following were the chief sub-contractors to the British Thomson-Houston Company, Limited:—

Permanent way, power house buildings, &c.	Mr. W. M. Murphy, Dublin
Engines	Messrs. R. W. Blackwell & Co., London.
Boilers	Messrs. Babcock & Wilcox, Limited, London.
Auxiliary apparatus, pumps, condensers, &c.	The Wheeler Condenser and Engineering Company and the Blake and Knowles Steam Pump Works, Limited, London.
Battery	The Tudor Accumulator Company, Limited, London.
Traveller	Messrs. Jessop & Appleby, Leicester.
Cars	The Brush Electrical Engineering Company, Limited, Loughborough.

Peckham trucks	Messrs. R. W. Blackwell & Co., London.
Overhead line construction...	Messrs. R. W. Blackwell & Co., London.
Lighting network and cables	Callender's Cable and Construction Company, Limited, London.
Arc lamps and hoods ...	The General Electric Company, Limited, London.

Alderman Fitzgerald, of Cork, was sub-contractor to Mr. W. M. Murphy for the buildings in connection with the power house.

SALISBURY ELECTRICITY WORKS.

In 1894 a few enterprising gentlemen started the Electric Light Company in Salisbury. They secured an option to purchase the old Town Mills and adjoining land as a site for the works, and in due course obtained a provisional order. As the Board of Trade threatened to rescind the order, the company approached Messrs. Edmundsons, of Westminster, who undertook to find a portion of the capital required if the remainder was procured locally. Only a small further sum was subscribed locally, but Messrs. Edmundsons having, in the meanwhile, largely increased their capital for the express purpose of dealing with such contracts, eventually undertook to put down the works, finding nearly all the capital required. The works in Salisbury have throughout been designed and carried out by Messrs. Edmundsons, and we think they have every reason to be proud of the result. Mr. L. A. Hards, who acted as their resident engineer, is now engineer to the Salisbury company.

A better position for a supply works than the old Town Mills it would hardly be possible to secure, it being not more than 100 yards from the centre of the city; the site is about half an acre in extent, and was the property of the Dean and Chapter of the cathedral for seven centuries. The old Town Mills is on the site where a mill probably already stood when the city was moved in the thirteenth century from its first position on the top of a neighbouring hill to its present situation at the junction of the Avon and the Nadder, the former of which now supplies part of the energy for supplying light in the city. Quite a number of interesting curiosities were found during the excavations.

The present mill buildings are only about 150 years old, and were fitted with four undershot wheels, which were used for flour and snuff grinding. One of these had been removed, and an iron eel trap grating fitted in its place.

It would take much too long, although it would be an interesting task, to describe the manner in which the old mill has been altered into an up-to-date electricity works.

At the east end of the works is a new two-storied building, used as an office and showroom, with a store and workshop below.

General View of Interior.

The next building is the old four-storey mill, having on the ground floor the eel trap, tank, and storm water-gate at one end, and further storage room at the other. On the first and second floors are the accumulators. The upper floors are empty.

The engine room is a new building containing the turbine, engine, and dynamos.

The boiler house is at right angles to the engine room, and the triangular shaped room between is intended to hold the condensers when the load on the steam plant warrants the cost of adding these.

The whole of the engine and boiler house are built of fireproof materials, the roof being iron, glass, and tiles, the walls are built for the most part of flints set in cement.

As the buildings are in such a prominent position in the city, Mr. E. Doran Webb, the architect, refused to have any-

thing to do with the work, unless he was allowed to design a building and chimney as little unsightly as possible, and certainly we must congratulate him on what is probably the most picturesque edifice of the sort in England.

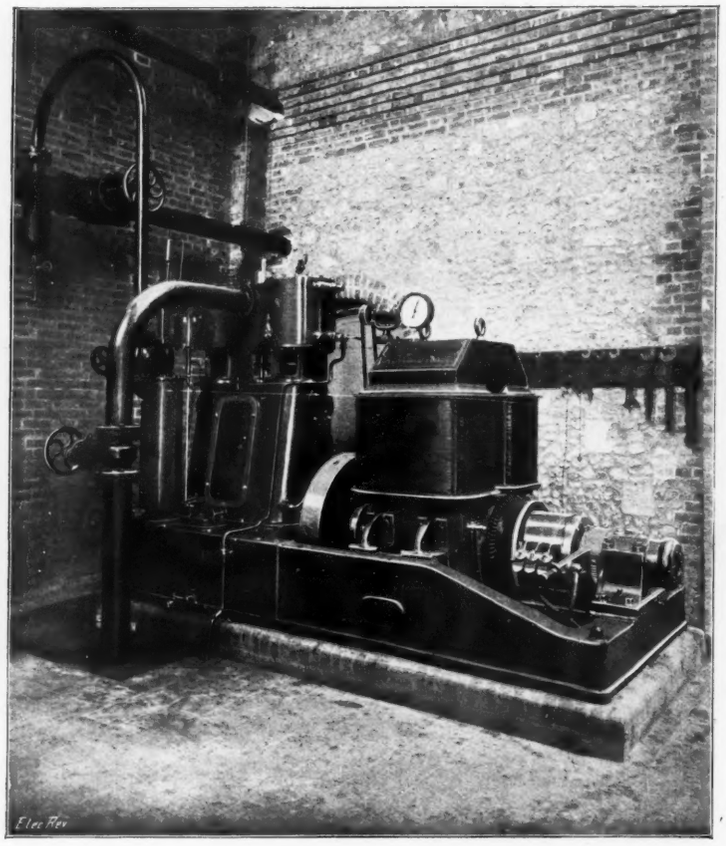
A siding of the L. and S.W.R. adjoins the company's property; some day no doubt this will be made use of, but for the present, as the consumption of coal will be small, it will be carted to the works.

The builder of the works was Mr. E. Hale, of Salisbury, and of the chimney Mr. J. Thompson, of Peterborough.

The chimney is octagonal, 100 feet high and 6 feet diameter inside.

There are at present in place a 50-H.P. vortex turbine and Parker dynamo, one Babcock and Wilcox boiler of 1,218 square feet heating surface, two Worthington feed pumps, one of Joseph Wright's Excelsior feed heaters, and a Belliss-Parker set of 84 kilowatts output, 180 amperes, and 460 volts.

Space has been left and all provision made for adding another boiler and engine set when required, but it is probable that so much useful work can be obtained from the turbine that these will not be required for another year.



Steam Set.

The steam pipes are on the usual ring main principle, and the feed pipes, &c., in duplicate.

A galvanised iron tank capable of holding 2,000 gallons is supported by an arch high up in the boiler house, to give a supply by gravitation to the feed heater.

The Original Old Town Mills.

The supply in Salisbury is at present being given from the turbine, which is one of Messrs. Gilkes of Kendal's make, with revolving wheel 8 feet 6 inches diameter, and is capable of giving 60 H.P. with 5,883 cubic feet of water per minute working under a 7 feet head. It runs at 28 revolutions per minute, and drives the dynamo at 200 revolutions by gearing and belting.

The turbine is fitted with movable guide blades for adapting the entrance orifices to any quantity of water below the full supply. These are fitted with gearing for adjusting them. The hand wheel for this purpose is placed most conveniently in the centre of the switchboard. As the plates of the turbine are very massive, it is quite hard work to close them, and an electric motor is to be fitted to give the switchboard attendant a quicker and easier control. The whole of the regulation is carried out by this wheel, there being no use in inserting resistance in the field of the turbine-driven dynamo, as the wheel only runs the faster to make up for the weaker field.

The dynamo driven by this turbine is composed of two machines coupled together, each capable of giving an output of 100 amperes at 230 volts, one machine being connected each side of the three-wire system. On the ends of the dynamos are coupled the boosters, to add the extra pressure for charging the accumulators.

The armatures of the boosters are wound on a sleeve and slipped on to the end of the spindles of the dynamos.

In the event of the turbine being out of use, this machine can be used as an ordinary balancer booster combination by the removal of the belt.

The switchboard was made by Thos. Parker, Limited, to Messrs. Edmundsons' designs, and is very compact; indeed, if one may find a fault, it is a little too crowded. It is divided into three parts. On the left-hand are the switches, ammeters, auto cut-outs, &c., for the combination dynamo and booster, also the battery regulating switches and ammeters, the throw-over switches, zero indicators, &c. On the right-hand panel are the feeder, ammeters, and duplex cut-outs, the dynamo ammeters, auto cut-outs, fuses, &c.

The centre panel carries the recording voltmeters, recording ammeter on the earth connection to the neutral wire, cut-outs, switches, &c., for testing the insulation of the mains.

Through the centre of this panel projects the spindle of the gear for opening and closing the blades of the turbine, and an indicator is fixed, showing the position of the blades, and also the level of the top and bottom water, so that at a glance the attendant can see the position of affairs.

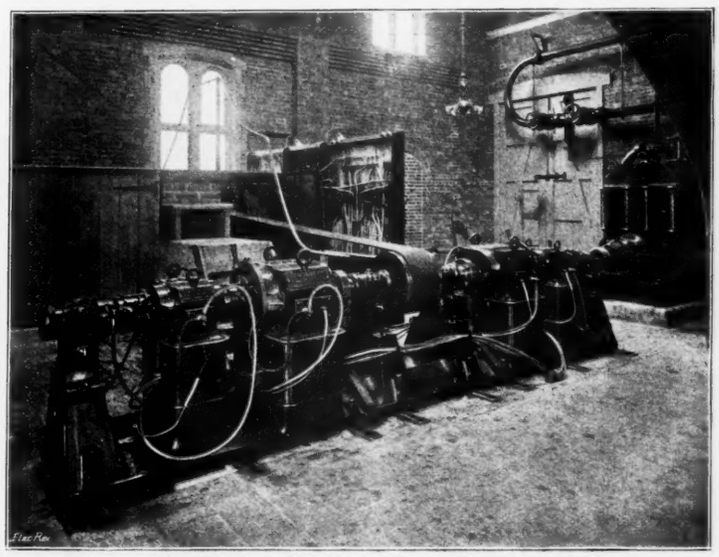
Two Kelvin large dial voltmeters—one on each side of the system—are fitted on the side wall, so that they can be seen when standing in front of the switchboard, or any part of the

engine room. The pressure at the consumers' lamps is 210 volts.

Thomson-Houston meters are fitted on the output of the dynamos and on the battery circuits; these latter read forward when charging and backwards when discharging, and therefore give the energy lost in the cells.

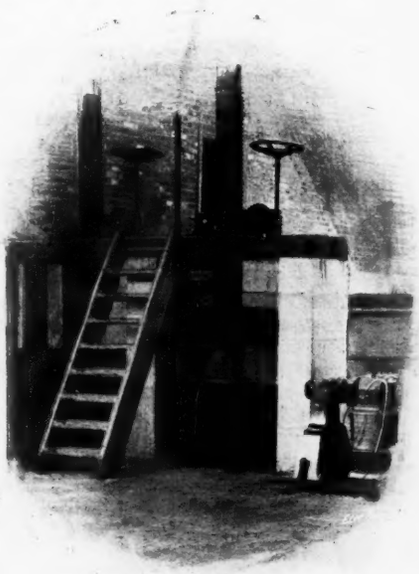
There are 230 accumulators, D.P. type, 715 ampere-hour capacity, 80 amperes at 420 volts for nine hours, or 119 amperes for four hours.

At present the turbine runs for about 18 hours daily—in the morning for charging and in the evening with the cells to supply the light required. The water-power varies very considerably, but even in the driest weather of last autumn there was always about 15 H.P. available. The average amount is 25 to 30 H.P., and when the river is flowing full 50 to 60 H.P. With the aid of a large battery this power will be sufficient for a large portion of the current required in a small town like Salisbury, and is of great advantage as regards the cost of supply.



Turbine driven Dynamos.

The mains are of Messrs. Callender's jute insulated lead-covered and armoured type, the feeders being concentric and the distributors three-core.



Portion of Turbine Plant.

The lengths laid are :—

Feeder No. 1	117 yards		
Feeder No. 2	711 „		
Sub-feeder	567 „		
Distributor	893 „		·100
	584 „		·075
	5,285 „		·05

Already considerable extensions of the mains have been laid, owing to the demand for light in the residential district of the city.

In August last the Corporation advertised for tenders for street lighting. They had previously been paying about £902 a year for gas, some of the lamps being extinguished at 11.0 p.m. for part of the year. The estimated extra cost of all night lighting was £136 — total, £1,038.

The electric light company quoted for 16 arc lamps (and 25 incandescents after 11.30) and 245 incandescents burning all night, £704; but the gas company reduced their price to £575 for all night lamps and secured the contract for three years. Taking into account a number of additional lamps which are to be fixed, the advent of the electric light company saved the city some £500 per annum.

Salisbury has a population of about 16,000 inhabitants and contains no very large hotels, colleges, or public buildings, so that to have secured the equivalent of 2,500 8-C.P. lamps connected since the supply was started in July is auspicious of a successful career. With the water-power the running expenses should work out very small, and we shall look forward with interest to the publication of the result of the first year's working, which we are satisfied should prove a record for a supply works of this size.

The formal opening took place on Monday last, the Right Hon. the Earl of Pembroke starting the machinery. In the evening there was a festal gathering at the "White Hart Hotel," in response to the invitations of the directors of the Salisbury Electric Light and Supply Company, Limited. The chairman, Mr. Gramshaw, having proposed the usual loyal toast, and in order to anticipate the departure of some of the guests who had to return to London, Ald. Hammick proposed the toast of "The Visitors," and coupled with it the name of Mr. Tom Callender. In so doing he congratulated Mr. Callender on the way in which his firm had carried out the work of laying the cables, and the freedom from vexatious interference with traffic arrangements. Mr. Callender, in a felicitous speech, foretold the rapid growth of the supply station. The toast of "The Company" was then given, to which Mr. Gripper responded in a ready and witty speech directed in a friendly and facetious way at the gas interests. Mr. Gramshaw proposed the "Mayor and Corporation," coupled with the name of Councillor Alexander, the mayor. That gentleman having responded, Councillor Marlow gave "The Local Visitors," to which Mr. Brickler and General Holling replied, and the proceedings soon after terminated, at least so far as the official festivities were concerned.

Among the principal guests were Mr. Pownall, town clerk, Mr. Boothams, assistant borough surveyor; Ald. Griffin; Councillor Haskins; Mr. Proctor; Mr. J. C. Wigham; Mr. Mayes, Ventnor; Mr. Malden, secretary to the company; Mr. Hards, the resident engineer, and various other members of the Corporation, several of the largest consumers, and representatives of the local press.

Chancery Notice.—Mr. F. F. Bennett, of Manchester, informs us that the Court of Chancery have now realised all the assets of the late firm of Bennett & Druce, of Preston, and a dividend of 20s. in the £ is being paid in same.

THE USE OF MECHANICAL POWER.*

What a Penny Saved per Car Mile means.

For the benefit of members of local authorities who are, perhaps, for the first time, directing serious attention to tramway questions, we have drawn up a table which will show at a glance the effect of reducing the working expenses of a tramway by 1d. per car mile run. The tramway director or manager does not need to trouble himself with these figures, unless for the purpose of handy reference, but to many members of local authorities they may open a new vista. The table is drawn up on a basis of an average car speed, including stoppages, of six miles an hour. If a higher speed, say, eight miles an hour, were postulated, the only column in the table requiring material alteration would be the second, as fewer cars per mile of double track would be required. As the cars would, however, be running proportionately faster, the mileage made per mile of track and the money columns would be approximately the same. In making an installation there would be a saving in the capital invested in cars, especially if electricity were used; but, owing to the higher speed, the power to be provided at the power station would be about the same. The following is the table:—

Salisbury Electricity Works.—The Old Town Mills up-to-date.

Minutes headway.	Cars per double track mile.	Car miles per double track mile per day of 18 hours.	Additional annual profit per double track mile from saving 1d. per car mile.	Additional capital per double track mile on which the added profit would pay 5 per cent.
			£	£
10	2	216	328	6,560
7	3	324	492	9,840
5	4	432	656	13,120
4	5	540	820	16,400
3	7	756	1,150	25,000
2	10	1,080	1,642	32,840
1½	14	1,512	2,300	46,000

It will be noted that for a 10 and a 7-minute service the saving of 1d. per car mile capitalised at 5 per cent. hardly warrants a very costly reconstruction. For such services the trolley wire system would no doubt be adopted, other things being favourable; and if the existing tracks were thoroughly good and strong, the sums in the last column would be more than sufficient for installing electricity. But two points must be noticed. The first is that on any isolated tramways where none of the lines require a more frequent service than 7 or 10 minutes, it is scarcely likely that any expensive change in motive power would be carried out without careful consideration as to prospects of increased traffic. But, as a rule, these quiet lines are merely the suburban extensions of larger and busier systems, and as such could be equipped and worked electrically or by cable very cheaply compared with what would be the case if they stood by themselves. The second point is that the saving as compared with horse traction would with electricity almost certainly be more than 1d. per car mile. It is quite possible that it would be 2d., and in that case the sums in the money columns would be doubled.

When we come to a 5-minute headway we enter the region where, if the routes were suitable, electric and cable traction would probably be about equally economical to work, though the capital expenditure for cable would be somewhat greater. If the route was very hilly cable traction would show greater economy in comparison than if it were approximately level. On the cable system we might look for a saving per car mile of about 2d. It is not easy to speak with certainty as to the saving by electricity, as expenses vary so much in different circumstances and localities, but still we might hope for nearly, if not quite, 2d. With the cable system greater confidence may be felt in prophesying. But when we come to a headway of 3 minutes or less, any uncertainty as to adopting either form of traction disappears, because it is plain that a saving of 1d. per car mile more than covers any capital expenditure necessary to make the conversion—an expenditure which for such services would be about the same for either system of traction. Speaking generally, the electric system does not show a very great reduction in working cost per car mile as the service increases in frequency; but at all events we can be sure of 1d. of saving as compared with horses, even though we neglect the increased public patronage from improved motive power. As for the cable system, it is absolutely certain that on such mileages the saving would be 3d. per car mile, while 4d. might with some confidence be anticipated. These savings go upon the assumption that the expenses for horse traction are on the usual scale of from 9d. to 10d. per car mile. If the higher speed of 8 miles an hour is taken, wages and some other heavy items per mile run would be diminished still more, and then the saving of 4d. would become almost certain. On a 2-minutes' service it will be noted this saving, capitalised at 5 per cent., represents fully

* *Railway World.*

£130,000 per double-track mile. Under most unfavourable local conditions as to curves, narrow streets, and slow speeds, we could look for, at the very least, a saving of 2d. Yet there are people who "boggle" over spending £20,000 or £25,000 per mile of street for the installation of cable or electric haulage on lines of dense traffic.

TELEGRAPH AND TELEPHONE NOTES.

All-British Pacific Cable.—The *Times* Ottawa correspondent telegraphed on 19th inst.:—"It is now announced on authority that the Dominion has offered to contribute an equal share with the Imperial Government of the cost of the construction of the Pacific cable, the joint obligation not to exceed five-ninths of the whole cost. The Australian colonies have undertaken to contribute the balance." In reference to this announcement the *St. James's Gazette* remarks that it is one of first-rate importance. "It would seem that at last some of the serious difficulties which have stood in the way of the successful accomplishment of the project have been removed. Canada has offered to contribute an equal share with the Imperial Government of the cost of construction, and it is further stated that the Australasian colonies have consented to contribute the balance. Once again has the Dominion stood out boldly on behalf of a scheme, the imperial importance of which cannot be exaggerated. As for Australia, it is obvious that the Antipodean Cabinets have all along favoured the Pacific cable in preference to that which it was proposed to construct *viâ* the Cape, to which reference was made in these columns recently. Meanwhile, it is to be hoped that the Pacific cable will speedily be laid, and if at some future date a further means of communication with Australia could be found in a line which should touch at the Cape, so much the better. Then, for the first time, we should see an all-British telegraph cable girdling the earth."

The Amazon Cable.—An American India-rubber journal says: "On September 28th a cable steamer left London with 100 miles of submarine cable for the Amazon Telegraph Company, Limited, to be laid in the Amazon, indicating that further repairs are needed in the ill-fated cable in that river. The core consists of 7-strand copper conductor, weighing 130 lbs. per mile, insulated with an equal weight of Hooper's patent India-rubber."

French Telephones.—According to the *Times* Paris correspondent a telephone to Brest was opened last Saturday. It will probably be extended to Cherbourg. A line to Luxenburg, *viâ* Longwy and Nancy has also been arranged for.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies—		
St. Lucia-St. Vincent ...	Sept. 24th, 1898 ...	...
Amazon Company's cable—		
Cable beyond Gurupa ...	June 8th, 1898 ...	...
Dartmouth-Guernsey ...	Dec. 1st, 1898 ...	Dec. 15th, 1898.
New York-Hayti	Nov. 30th, 1898 ...	...
Para-Maranham	Nov. 25th, 1898 ...	...
Sitia-Candie	Dec. 16th, 1898 ...	...
Landlines.		
Majunga-Tananarive ...	Dec. 17th, 1898 ...	...
Saigon-Bangkok	Dec. 16th, 1898. ...	Dec. 16th, 1898
" "	Dec. 20th, 1898 ...	...

Telegraphs to Fashoda.—A Reuter's despatch from Cairo says that after Lord Kitchener's arrival at Omdurman, the construction of telegraph lines will be begun to Fashoda and the Sobat River, and also between Kassala, Gedaref, and Sennaar.

The Telephone in South Africa.—The *Cape Times* says:—"It is understood that the postal authorities have under consideration a proposal to connect the leading towns in the Eastern Province by telephone. The connection will be applied to Port Elizabeth, Graham's Town, King William's Town, East London, and Queen's Town."

The Telephone Purchase.—The subjoined important letter appearing in the *Times* from the president of the National Telephone Company gives a cautiously worded but decided approval to the suggestions made by Mr. Edward Rae with a view to arriving at a basis for "nationalising" the telephone system:—"Oxford Court, Cannon Street, E.C., December 13th. The letters from Mr. Edward Rae appearing in the *Times* of 16th and 30th ult., suggesting the advantages which would arise from the absorption of the business and machinery of the National Telephone Company by the State, have naturally received the most careful consideration and attention of the board. The board are sensible of the deficiencies of the present system, but must remark that these are greatly attributable to the want of proper facilities for construction and maintenance of plant; to the insecurity of the present tenure of the company, and to the absence of those favourable conditions which apply to other companies conducting public services under the authority of Parliament. The board are, and have been, only too anxious to co-operate with the Post Office (as that department can testify) in effecting improvements and development in the business; and if, as seems to be possible, the drift of public opinion should result in the desire to transfer the telephone business to the State, they would feel it to be their duty, upon reasonable and fair terms, loyally to co-operate in bringing about the change, and, subject to the responsibility of consulting the shareholders, I am authorised to say, in answer to Mr. Rae's first question, that his proposal, if it should assume a practical shape, that is to say, if the Government should entertain the question of purchase, would form an acceptable basis of negotiation; and, to his second, that on the assumption that the business be conducted on commercial principles, the future earning capacity from year to year is not over-estimated; but, on the contrary, if the restrictions and difficulties now attending the operations of the company be removed, they are largely under-estimated.—J. S. Forbes, President."

CONTRACTS OPEN AND CLOSED.

OPEN.

Burnley.—January 10th. The Corporation wants tenders for underground electric light cables and switchboard. See our "Official Notices" December 16th.

Christiania.—January 4th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul-General at Christiania stating that tenders are invited by the Norwegian State Railways Administration for the delivery of various telegraph and telephone materials. Tenders, in sealed envelopes, marked "Telegrafog Telefonmateriel," must be received at "Styrelsens Expeditionskontor, Statsbanerne, Christiania," by 7 p.m. on January 4th, 1899. A copy of the conditions of contract may be examined on personal application at the Commercial Department of the Foreign Office, S.W., any day between the hours of 11 a.m. and 5 p.m.

Cumberland.—January 2nd. The Visitors' Committee of the Cumberland and Westmorland Asylum invites tenders for the supply and erection of an electric tell-tale clock with 30 stations. See our "Official Notices" December 16th.

Dublin.—December 28th. The Corporation is inviting tenders for the supply of a high tension single-pole switchboard. Specifications and drawings can be seen at the offices of Prof. Kennedy, 17, Victoria Street, S.W., and copies can be obtained from the City Engineer. See our "Official Notices" December 16th.

Edinburgh.—January 9th. The Council invites tenders for switchboard and boosters for the Macdonald Road lighting station. See our "Official Notices" December 16th.

Glasgow.—January 21st. The Corporation invites tenders for generating plant at one or other of their new electricity works:—Two engines each of 200, and two of 400; three of 1,100, and two of 2,200 indicated horse-power, with dynamos and condensing plant. Specifications, forms of tender, &c., from Mr. Chamen, city electrical engineer. See our "Official Notices" December 16th.

Leeds.—December 29th. The Council is inviting tenders for underground conductors, switchboards, &c., in connection with the electric tramways. Particulars from the city engineer or Messrs. Hopkinson & Talbot, 26, Victoria Street, S.W. See our "Official Notices" December 9th for particulars.

Londonderry.—December 24th. The Corporation wants tenders for the supply of arc lamp globes and carbons, for the year ending December 31st, 1899. See our "Official Notices" December 16th.

London, N.—The Mildmay Radical Club wants tenders, under certain conditions, for an electric light installation for the Club and Institute, 34, Newington Green, N. See our "Official Notices" this week for particulars.

Norway.—January 4th. The Norwegian State railway authorities in Christiania are inviting tenders until January 4th for the supply of 14 tons of telegraph wire, 3,500 porcelain insulators, 10,000 zinc rods for primary batteries, 1,000 zinc cylinders and 4 kilometres of insulated copper wire. Particulars may be obtained from the Bureau des Telegraphen-Inspectors, Ostbahn Station, in Christiania, and tenders marked "Telegrafog Telefonmateriel," are to be sent to the Expeditionsbureau der Verwaltung der Staatsbahnen, Jernbanetorvet 8/9, Christiania.

Stirling.—January 2nd. The Burgh Commissioners are inviting tenders for Lancashire boilers, engines, dynamos, pumps, piping, crane, accumulators, switchboard and boosters, arc lamps, and various other apparatus, &c., for the electric lighting of the town. Consulting engineer, Prof. A. B. W. Kennedy. See our "Official Notices" December 9th for particulars.

Sunderland.—December 30th. The Corporation wants tenders for the supply of three 125-kw. direct current high speed steam dynamos, 460 volts. Borough electrical engineer, Mr. J. F. C. Snell. See our "Official Notices" December 9th for particulars.

Tunbridge Wells.—January 11th. The Corporation is inviting tenders for the erection of three telephonic fire alarms within the borough. Tenders to the Town Clerk.

CLOSED.

Burton-on-Trent.—The Council recently invited tenders for a new engine and alternator for extensions, and 18 tenders were received. That of Messrs. Fowler & Co., of Leeds, has been accepted at £2,965.

Cheltenham.—The Council recently accepted the tender of Messrs. Nalder Bros. & Thompson for the supply of an accumulator and exciter switchboard at £290. Messrs. Siemens Bros. & Co. also tendered.

Llanrwst.—The tender of Messrs. Calvert & Co., of Manchester, has been accepted for electric lighting the town of Llanrwst, North Wales.

Liverpool.—The City Council has, on the recommendation of the Electric Power & Lighting Committee, entered into a contract with Messrs. Willans & Robinson, Limited, for the supply of four sets of plant similar to those on order for the Pumpfields station for £6,939 per set.

Shoreditch.—The Lighting Committee reported to the Vestry on Tuesday that Messrs. Glover & Co., the present contractors, were unable to effect an early delivery of the cable required for the extension of the lighting system in the district of Haggerston. The chief electrical engineer had suggested that the cable should be obtained from the British Insulated Wire Company at the following prices, which include supply, drawing in and jointing of the cable:—1°″ conductor, 11s. 6d. per yard; ·75°″ conductor, 9s. 4d. per yard; ·5°″ conductor, 6s. 5d. per yard; ·25°″ conductor, 3s. 8d. per yard. The committee recommended and it was decided to accept the tender.

FORTHCOMING EVENTS.

Tuesday, January 10th.—At 8 p.m. The Institution of Civil Engineers. Paper on "High-speed Engines." By John Handsley Dales, A.M.I.C.E.

Friday, January 13th.—At 8 p.m. The Institution of Civil Engineers. Students' Meeting. Dr. Archibald Barr, M.I.C.E. (Professor of Civil Engineering and Mechanics in the University of Glasgow), will deliver an address on "The Application of the Science of Mechanics to Engineering Practice."

NOTES.

Xmas Greeting.—On December 24th last we expressed the hope that electrical firms would be ready to start the New Year with a determination to regain the ground lost to them by the unfortunate strike amongst the members of the A.S.E., which at that date showed no signs of a speedy settlement. Since its termination the industrial trades seem to have been hard pressed to deliver old orders and make headway with new contracts, and altogether the engineering firms at all events, throughout the country, appear to be overwhelmed with work. This is a welcome change, and in wishing our friends and supporters a very Merry Xmas, we may be allowed to express the hope that business will long continue at high water mark to the mutual benefit of both masters and men.

The Copper Market.—At the first glance the last fortnightly statement of Messrs. H. R. Merton & Co. will be considered more reassuring by large consumers of copper than any that has been issued for several months. The upward movement of copper has at last ceased, and the price of G.M.B's. for the fortnight ending December 15th is given as £55 6s. 3d., a drop of 16s. 3d., upon the price ruling during the previous fortnight. The cause of this sharp fall is not very apparent from the statistics given in Messrs. Merton's circular. The total English and French supplies for the fortnight are only 7 tons in excess of the deliveries, and the stocks of copper ashore and afloat have only advanced from 26,897 tons to 26,904 tons on December 15th. Possibly the cause is to be found in buyers holding aloof and only buying in order to cover their requirements at the moment; and it would be a mistake to assume from this sharp fall in copper that the period of high prices is over, and that the metal will soon sink to its normal level of £50 per ton. This desirable state of the market from the consumer's point of view can only arrive when there is a much larger surplus of copper than at the present date, and the fall in price will probably occur *gradually*, as the result of a slow accumulation of stocks during the coming year. We shall probably have occasion to refer to this subject again next week.

Electric Avenue.—In our issue of December 24th, of last year, we made special mention of this electrically lighted avenue, the pride of Brixton, and the display this year is in no way inferior to that of 1897, although the arrangement of the evergreen festoons and electric lamps is quite changed. Last Christmas 30 festoons ran across the street at short distances apart, and some 300 incandescent lamps were picturesquely placed amongst the evergreens. To-day the decorations and some 400 glow lamps are alongside each footway with a huge crown of firs and laurels across the middle containing 54 incandescents to light it up, and at the Brixton Road end are two large stars, each illumined by five 50-C.P. lamps. Six arcs at intervals in the middle of the road, in addition to those along the footway to the total number of about 120, make the avenue a perfect blaze of light. Mr. Christie, the estimable engineer in charge of the Avenue central station is again responsible for the lighting portion of the exhibit, which does him infinite credit, and once more we repeat that everybody should go and see this beautiful and unique display. An object lesson, too, in the central station is the perfect running of a Westinghouse engine, by Alley & Maclellan, which Mr. Christie cannot praise too highly after some three years' freedom from trouble or repairs.

Rope Driving.—We have received from Ironmongers' Rope Works, Limited, Wolverhampton, a specimen of the paper rope to which we referred last week on page 910. It is simply a rope made in the usual way from threads of twisted manila paper. It is said to possess wonderful wearing power, and when treated with a special composition is practically waterproof and, therefore, will be suitable for use even in damp air. Mr. Ironmonger has had one running for a considerable time, and he believes it will, in time, take a foremost place among ropes for transmission purposes. He encloses, also, a small piece of the worn rope, in which we notice the polished condition of the strands inside, where friction generally results in the wearing away of hemp or cotton ropes. Unfortunately, the three or four-strand question is still unsettled. One of the leading makers, and many engineers in Lancashire still advocates the four-strand form. As many engineers must be interested in rope driving, we would advise them to examine this paper rope which seems worthy of serious attention.

Electricity on H.M.S. "Irresistible."—Three independent sets of dynamos and engines are required to light H.M.S. *Irresistible* (first-class battleship, which was christened at Chatham Dockyard on the 15th inst. by H.R.H. Princess Christian), and to work the electric motor fans and the six powerful search-lights with which the ship is fitted. Every compartment of the vessel, except in the double bottoms, will be lighted by incandescent lamps, and Colomb's lights are fitted for use when the dynamos are not running. The ventilation will be secured by means of the motor fans. There is also to be a complete installation of electric bells and voice pipes, together with a system of loud speaking telephones in various parts of the vessel. There is a steam capstan forward, but the after capstan is to be worked by two electric motors, supplied by Messrs. Clarke, Chapman & Co., of Gateshead-on-Tyne.

Appointments Vacant.—The Manchester Tramways Committee wants a competent engineer to assist in engineering work in connection with the conversion of the exisiting lines to electric traction; salary £200 per annum. A temporary engineering assistant at 50s. per week is also wanted for the same department. See our "Official Notices" this week.

The Urban District Council of St. Annes-on-the-Sea, Lancs., want an electrical engineer to design and superintend the erection of electricity works at £170 per annum. See our "Official Notices."

The L.C.C. Tramways Appointment.—The Nottingham Tramways Committee has informed Mr. Baker, the chief officer of tramways that it cannot release him in less than six months. The L.C.C. recently appointed him in connection with the London tramways. For the present tramway matters are to be managed by a committee.

The Weston Standard Cell.—The Weston standard cell, in which cadmium replaces zinc used in cells of the Clark type, has been examined by Jaeger and Wachsmuth (*Ann. Phys. Chem.*, 1896 (2), 59, 575—591). These authors found irregularities in the behaviour of certain of the cells dealt with between 0° and 15° C., and an investigation was recently undertaken by Ph. Kohnstamm and Ernst Cohen for the purpose of ascertaining the cause of this peculiarity. Attention was, in the first place, directed to the crystallised cadmium sulphate used in the cell. As some doubt exists with reference to the composition of this salt, careful analyses were made and were found to be in agreement with the usually accepted formula, $3CdSO_4 + 8H_2O$. Solubility determinations and the investigation of some other properties of the solutions show that this salt undergoes some change at 15°, and that it is this change which affects the behaviour of the Weston cell at this temperature. The salt does not, however, appear to change in composition. For practical purposes, therefore, the use of the Weston cell should be restricted to temperatures above 15°. For further details consult the *Ann. Phys. Chem* (II.), No. 65, p. 344, for the original paper.

The Comparative Efficiency of Water-Tube and Water-Tank Boilers.—There appears in the *Practical Engineer*, by Geo. Akhurst, one of the best comparisons we have seen between water-tube and shell boilers. He disposes of the numerous fallacious ideas which are based on an entire misconception of the relations of water capacity, duration of steam raising, steam dryness, and so on. He considers water-tube boilers are altogether behind shell boilers in economy, and he instances the water-tube boilers of H.M.S. *Terrible*, which burn 1·71 to 2·17 lbs. per I.H.P.-hour with a pressure of 240 lbs., whereas shell boilers at 160 lbs. pressure commonly attain the lowest figure of 1·71 lbs. Our author does not consider that the Scotch or shell boiler will be displaced until pressures of 300 lbs. enable the engines to secure by high pressure a sufficient advantage to over-balance the lower efficiency of the boiler as a fuel user. It is still, however, open to makers of shell boilers to provide for even 300 lbs. pressure. Already they have coped with 250 lbs., and finality has not been reached in materials. For marine purposes the complicated brickwork of water-tube boilers is unfavourable to them. The features of the water-tube boiler to give it an advantage in places are its sectional character, an ability to stand the highest practical pressures which the future may yield, and greater safety at high pressures when materials are perhaps weakened by excess of temperature. But for steady steaming, especially on intermittent work, larger water capacity is an essential. Water-tube boilers are also more limited in their choice of water, which must be good, free from incrusting matter, and non-corrosive.

An American View of the London Tramway Situation.—Mr. Albert L. Johnson, of the Nassau Electric Railroad Company, who has done a great deal of electric railway construction work in America, has recently been paying a visit to London, and in an interview with the London representative of a New York newspaper he has been giving his impressions of the tramway situation here. Mr. Johnson is reported to have said:—"There is no doubt in the world that in the next 18 months electric railways will have gained a decided footing in the city of London. I have been invited here to consult with other experts on the proposition, and whether I or someone else put in these lines makes little difference. They are bound to come. I have been engaged for the last 10 days in looking over the entire field, and I can safely say that there is no place where the natural conditions for electric street railway construction are so good or where there is such a demand for them as in this great city. . . . . All the underground and tramway prices in London are ridiculously out of proportion to the length of space covered, and there is no reason why people should not travel just as cheaply here as they do in New York. As I said before, there is the greatest opportunity for electric railway construction in London offered by any place in the world, and it is the only solution to the vexed question of congested London traffic. I expect that some definite results will be obtained within a short time." Probably Mr. Johnson is reckoning without the London County Council.

The Rise in the Price of Copper and Copper Company Flotations.—As a result of the high price of copper, there is quite a small "boom" occurring in the copper mining world, and during the past ten days the prospectuses of three copper mining companies have appeared in the daily papers. In a note in our last issue we gave some details of the most important of these—the Le Roi Mining Company, formed to purchase and work mines in British Columbia. We now give some particulars of the other two companies. The first, the Copper Corporation of Chili, has a capital of £200,000, and is formed to purchase and work mines situated in the province of Atecama, Chili, which have previously been worked. £130,000 is to be paid to the vendors who are *re-selling* at a profit; and the expenditure of £25,000 will be required to place the mines and plant in good working order. The second company is the Mid-Moonta Copper Mines, capital £130,000. The mines which this company is to purchase and work cover 152 acres, and are situated in South Australia. The vendors have spent £4,000 upon developments, and are now *re-selling* at a profit. The purchase price is fixed at £100,000 in cash and shares. From the copper consumers' point of view this promotion of new companies and development of new mines at the present moment is wholly beneficial; since the greater the production of copper and the larger the number of independent mining companies, the more rapid will be the decline in the present abnormally high price of copper. From the investors' point of view, however, the present "boom" in copper company flotations is not an unmixed blessing. At the present price of copper, it is exceptionally easy to show remarkable returns upon capital in these propectuses; and the danger lies in the readiness of promoters to take advantage of this fact, and to obtain for the properties sold, prices much beyond their real value. Over-capitalisation with its concomitant evils is thus likely to occur; and we take this opportunity to warn our readers of the risk they are taking in investing in these new copper mining companies without first obtaining expert opinion upon the statements made.

High Speed Steam Engines.—There appears a plea for high rotative speed in the *Engineering Times* by Mr. Norris. He points out the saving of steam which high speed secures, and attributes this to the greater ratio of the weight of steam per unit of time to the weight of the cylinder. He says a fixed amount of condensation and re-evaporation must go on in a given time; but he does not make it quite clear that the benefits of high rotative speed with short stroke are largely in the reduction of the time duration per stroke and the increase of the cylinder volume per unit of circumference. Against this latter is to be placed the increase of area of the cover surfaces and piston surfaces whose action is, perhaps, the most pernicious of any part of the cylinder, and it is very doubtful if the most has been done with long-stroke engines, whether the mean speed of piston has not been too much reduced in the high rotation engine, which has an abnormally large area of cylinder and piston ends in relation to piston speed. Mr. Norris is wrong in claiming that the high rotation engine has so much power for its size. This is not so per cylinder volume. It is entirely to the small duration of each revolution period that this engine owes any economy it may possess in respect of reduced cylinder condensation, and, considering the large area of steam exposed surface in such engines, it is clear that if there is any reduction of cylinder condensation the effect of rapid rotation must indeed be good, for an economy has been even effected in face of an increased ratio of surface. Hence it follows that further economy may probably be secured from longer strokes, so as to raise the piston speeds of high rotation engines. He claims superheating as being more effective in high speed engines and less of it being required, which, of course, follows naturally as a corrollary on the gain due to shortening the period of revolution.

Lectures.—At a recent meeting of the South Staffordshire Institute of Iron and Steel Works Managers, at the Mechanics' Institute, Dudley, Mr. Horace Allen, C.E., read a paper on "The Blast Furnace as a Source of Power."

At the University Engineering College, Glasgow, last week, Mr. W. B. Sayers lectured on "The Economic Use of Electricity in Power Transmission and Distribution."

A New Electric Motor.—The *Colliery Manager* has the following :—

Mr. J. M. Hiley, foreman electrician with Messrs. Maxwell & Son, Dundee, has invented and patented an electric motor. The machine is designed to utilise the current employed for lighting purposes on its passage to the lamps without diminishing the power thereof. At present the electric energy loses a proportion of its power on its way along the wires; but Mr. Hiley's motor will prevent this loss, and intercept for its own propulsion the energy which would otherwise be wasted. He has departed from the usual way of constructing motors, in so far that his machine is an arrangement of horse-shoe electric magnets. The rotary part is composed of four of these magnets mounted on a spindle, and wound in such a manner that the current is commutated to change the polarity of any one of the magnets at a suitable moment. The poles being mounted on a metal disc, the current is free to pass from any one pole to any other. Therefore, any two adjacent poles may form a complete horse-shoe magnet. By partially rotating the brushes round the commutator the speed of the machine may be governed. The field magnet terminates in a T-piece—that is to say, each pole is extended on each side of its axis so as to be opposite two or more poles of the armature or rotating part. They are so fixed to cut out the torque at the moment there is a change of polarity in one of the rotating magnets. By this construction sufficient copper can be used in the winding to carry any desired amount of current. The machine can be placed in series with any number of lamps without interfering with the power. Mr. Hiley has caused a model to be fitted up in the window of a hattery establishment in Overgate, where it is working a revolving showcase, and has attracted a deal of attention. The current going to three of the lamps in the window is made use of to drive the motor, the other lamps being supplied from a separate circuit. The motor has had a good trial, and as yet no perceptible difference has been observed between the three lamps connected with the machine and those on the free circuit.

A correspondent asks to whom is the greater honour due —to the inventor of the motor, or to the writer of the article ?

Indicator Testing.—In the testing of indicators by means of a mercury column errors are very apt to arise, and these are pointed out by Prof. Jacobus in a recent paper wherein he describes other methods he has used. The measurement of pressure is obtained by him by means of a weight carried on a ground plug fitted in a ground hole and spun round to eliminate friction when taking the reading. In drawing the test lines a set should be taken after pressing down the indicator spring and after pulling it up. In each case it ought to return to the same place, the instrument being rapped by a wooden stick to eliminate friction. Differences of temperature will give double lines for the same pressures, so that in testing on a rising and falling pressure care must be taken to secure fairly even temperatures on both up and down tests. Apparatus is described for testing by steam, air, or water pressure. A good deal of opposition is likely to be made as to the idea of the unreliableness of the mercury column.

The City Electric Lighting.—The *City Press* understands, on the very highest authority, that there is every possibility of a conference taking place in the near future between the Streets Committee of the Corporation and the City of London Electric Lighting Company with reference to the purchase by the Corporation of the company's undertaking. The directors, it is understood, are quite prepared to sell their property if the terms offered are sufficiently tempting. Naturally, our contemporary is unable to give any indication of what the views of the board are as to the sum they will feel disposed to accept.

Mr. Alpheus C. Morton, as a member of the Streets Committee, writes to the *Daily Chronicle* denying that any arrangement has been made by that committee to hold a conference with the City Company on the question of purchase. He says the committee has practically refused to do anything of the sort.

Cowper-Coles Recuperative Electro-Zincing Process.—This process, which has been on several occasions noticed in our columns, is coming into extensive use, and is now being utilised for a great number of purposes, especially for the coating of torpedo-boat destroyers and the tubes of water-tube boilers, such as the "Belleville," the zinc being applied externally, that is, the fire side, not internally. A plant has been designed for the Germania Shipbuilding and Engineering Company at Tegel, near Berlin. It is specially constructed for coating tubes such as those used in the Thornycroft, Yarrow, and similar water-tube boilers.

The Largest Electric Plant in the World.—The *Westminster Gazette* says that a private cable message just received from New York gives interesting particulars regarding a contract which has been signed for the installation of what will be probably the largest electric railway plant, and for that matter the largest electric plant of any kind in the world. The Third Avenue Railway Company of New York, having decided to abandon its cable equipment for electric power, has awarded the contract for the steam and electrical equipment of its power house, which will contain machinery capable of developing 64,000 horse-power, and for its street railway lines, to the Westinghouse Electric and Manufacturing Company, of Pittsburg. The undertaking involves the expenditure of rather more than a million sterling, and the contract covers the steam engines, boilers, and entire steam plant, as well as the electric generators, motors, transformers, switchboard, and all other electrical apparatus required for the enterprise.

Personal.—We congratulate Mr. John F. C. Snell, A.M.I.C.E., M.I.Mech.E., M.I.E.E., upon his unanimous appointment by the Sunderland Corporation as engineer for the construction and subsequent running of the Corporation Tramways. A Bill is now before Parliament. Mr. Snell will be responsible for carrying out the whole of the scheme including the permanent way and car sheds, as well as the purely electrical overhead and other equipment. Mr. Snell also has in hand the large extensions to the present lighting station and plant both for lighting and traction purposes, and is further changing the existing system over to 440 volts. The Council have agreed to pay him 100 guineas for his tramways report. His present engagement is to be terminated, and a further five years' agreement entered into, on the following rates of salary :—First year, £600 ; second year, £700 ; third year, £750 ; fourth year, £800 ; fifth year, £800. We understand that Mr. Snell had previously received three offers of £600 a year.

We regret to hear that Major-General Webber met with a mishap the other day while cycling along the Thames Embankment, injuries to the cheek bone resulting. We are, however, pleased to learn that he is progressing satisfactorily.

On Examinations.—N. W. Sibley, B.A., LL.M., of Cambridge, rushed violently down a steep place into the *St. James' Gazette* last Monday, possessed by a spirit of antipathy to examinations in exact science. His text was a slip in the wording of an examination paper, set 12 years ago, and his conclusion that examinations are ridiculous. It may be observed that this syllogism consists of a major premiss and a conclusion. The minor premiss is omitted, but may perhaps be supplied. We fancy the future B.A. was plucked for his mechanics. At Oxford it would have been for logic. Now what is to be substituted for examinations ? Sokratic dialogue, he says, and studious attendance at lectures. It is likely our B.A. can discourse freely on the nature of true virtue, or the difference between ideal beauty and a B.A. degree, and is not quite so strong on rule of three, or the cause of the tides. The oversight of a tired examiner at the end of term does not alter the fact that selection can only be made after testing, and that the only important quality of a candidate that can be tested is his intellect and knowledge. The infinitely more important quality, his personality and character, cannot be tested at all.

Shock Fatality.—The inquest on the body of the man named Davis who was killed at Southampton while engaged repairing a joint of a high tension cable, was concluded on Tuesday, and a verdict returned of "Accidentally killed." The borough coroner, in the course of the hearing, said that he was really not surprised at what had happened. He had seen the men working in the High Street himself, and had asked them if they were not supplied with gloves, and they replied that they did not want them. He thought they would find that death was due to coming into contact with the wires without the proper gloves.

The City Company's Continuous Current Plant.—We understand that the continuous current plant of the City of London Electric Lighting Company is now ready, and further plant of 2,400-kw., all continuous current, is on order for delivery in February and June, 1899.

The Société des Electriciens.—The monthly sitting of the Société des Electriciens was held on 7th inst., at 8.30 p.m., M. Hillairet presiding. The secretary read the report of the last meeting, which was accepted, and the general secretary read out the names of various new members and mentioned certain inventions. M. Armagnat presented M. Blondel's new hysteresimeter, constructed by M. Carpentier. This apparatus consists, like Prof. Ewing's, of a U-shaped magnet, which can easily be made to turn round a vertical axis. Between the limbs of the magnet are arranged little iron rings of the sample to be tested. The part which holds these samples is mounted on a spring, which tends to bring it back to its original position. A little transmitting apparatus with a handle at the bottom enables the magnet to be turned. The magnetic field is displaced and draws the iron rings with it until the action of the spring that holds back the part supporting the rings makes equilibrium with the motive couple. A needle connected with the rings moves on a graduated dial. The figure indicated multiplied by a coefficient gives the loss in ergs per cubic centimetre. The iron discs are cut from the samples of iron to be tested and should not be thicker than 4 millimetres. M. Armagnat made several tests with this apparatus and obtained very satisfactory results. The comparative measurements are very exact. It would be difficult to deduce from them absolute measurements. M. Boucherot then presented a new apparatus for measuring motive couples. We know that in order to determine the motive couple we have only to write down the angular speed, to trace the curve of the angular speed as a function of the time, and to trace the tangent at any point whatever; we then take the angular coefficient. The object of M. Boucherot's apparatus is to enable the angular speed to be easily registered. M. Maurice Leblanc then spoke with reference to the employment of asynchronous alternating current machines as generators and motors. He showed that asynchronous machines branched upon a system can, according to various conditions which he determines by calculation, work sometimes as generators, and sometimes as motors.

The Manufacture of Chlorides, Bromates, Iodates, and Hypochlorites.—Students of patent literature which is concerned with electrolysis, may remember a patent granted to Schuckert for the addition of from 1 to 5 per cent. of alkali bi-carbonate to the anode chamber of a chloride decomposing cell in order to increase the yield of chlorate. W. Vaubel, in the course of other observations, has observed that when the anode chamber contains bi-carbonate of an alkali, and the cathode chamber a saturated solution of the corresponding chloride, and a diaphragm separates the two, a complete conversion of the chlorine into chlorate occurs in the anode compartment of the cell. He gives the following equation to explain this change :—

$$NaCl + 6\,NaHCO_3 = NaClO_3 + 6\,CO_2 + 6\,Na + 3\,H_2O.$$

The carbon dioxide is liberated as gas at the anode, and may be used to form fresh bi-carbonate with the hydrate produced at the cathode. In Vaubel's experiments, a temperature of between 60° and 70° C. was used; the current density varied between 5 and 10 amperes per square dm. (45 and 90 amperes per square ft.), the yield of chlorate being greater at the higher current density. The E.M.F. was from 4 to 6 volts, and 5 grammes of sodium bi-carbonate were added to each 100 cc. of anode liquid at intervals of four hours. This liquid was found to contain 6·5 grammes of sodium chlorate and 7·5 grammes of sodium bi-carbonate at the end of the experiment; and continuance of the electrolysis beyond this point was not found to be advantageous. The cathode liquid contained 10 per cent. of sodium hydrate. The yield of the latter represented a current efficiency of 90 per cent.; that of the chlorate one of about 50 per cent. The substitution of caustic alkalis for the bi-carbonate salts, caused formation of chlorides in the anode compartment of the cell. As regards energy efficiency, 736 watt-hours yielded about 50 grammes of sodium chlorate. Oettel, in his experiments upon this same subject, obtained 88·14 grammes of potassium chlorate from 736 watt-hours; but the E.M.F. used by him was only 3·3 volts, and he worked without any diaphragm with slightly alkaline chloride solutions. The Gall and Montlaur chlorate process is worked on a manufacturing scale. Diaphragms are used, and a solution of an alkali hydrate is supplied at intervals to the anode compartments of the cells. By this process, 1,003 watt-hours are required to yield 88·14 grammes of potassium chlorate, as against 951 watt-hours in the author's experiments. Though theoretically the author's method would appear to be the more profitable, experiments upon a large scale have shown that this is not actually the case. Bromates and iodates of exceptional purity can be produced by the same method as that described for chlorates. If a lower temperature than that named be employed, hypochlorites are formed without any chlorites; but the solution so obtained is very unstable. Experiments made by the author show that the oxidising properties of the bi-carbonate solution contained in the anode compartment of the cell could also be utilised in the production of Prussian blue. Attempts to oxidise barium hydrate in the same manner failed; but chromium hydrate was raised to the higher stage of oxidations. The yield in the latter case was, however, only 3 per cent. as against 47 per cent. by the Haussermann method. The attempt to produce fluorates in a similar manner failed. The experiments were carried out in the laboratory of Prof. Dieffenbach, at Darmstadt, and are described in a paper by W. Vaubel in the *Chem. Zeit*, 22, (34), 331.

Electric Motor Car Stations.—Under the title of "La Poste Electrique Internationale," a company has been formed in Belgium, with a capital of £320,000, for the novel purpose of establishing on all the principal high roads of Europe electric motive power stations, or electric posting stations for motor cars. A financial daily says that each of these stations will be in charge of expert mechanics, repairs will be quickly executed, and accumulators can be recharged.

Accumulator Competition.—Under the auspices of the Automobile Club de France a competition of accumulators suitable for electric motor vehicles is to be held in Paris on the second Monday in April next, and following days. The conditions of the competition, which is an international one, have just been issued.

The Northern Society of Electrical Engineers.—On Wednesday evening, at Manchester, a paper on "Commercial Instruments for Indicating and Recording Electrical Quantities," with a note on the new Aron meter, was read by Mr. E. S. Shoults.

Erratum.—By a compositor's error last week, the number of lamps applied for when the Eccles electricity works commenced operations was given as 45,000 instead of 4,500.

Thermophones.—The periodic changes of length or bulk produced by an oscillating current may be utilised for the electrical propagation of sound. The effect, according to an article in *Braun in Annal. Phys. Chem.*, abstracted in the *Scientific American*, may be indefinitely increased by superimposing a steady current upon the variable current. A bolometer is inserted in the secondary circuit of a small induction coil. As long as the secondary current alone traverses the bolometer, no sound is heard. But as soon as an independent constant current is made to traverse the bolometer, every impulse of the induced current produces a noise in the bolometer, which, in this case, acts like a telephone. The loudness increases with the strength of the steady current. On replacing the induction coil by a microphone, nothing is heard. But even then the sound may be brought out by Simon's sensitive arc. This is due to the strong steady current traversing the arc. If three or four secondary cells are put in circuit with a bolometer and a microphone, anything spoken into the latter is distinctly reproduced by the microphone. The bolometer may be replaced by strips of thin brass.

Obituary.—The death of Mr. John Randall Miles, Postal Telegraph engineer, is announced from Rainhill, near Prescot, from typhoid fever.

Curious Lightning Freak.—Light has at length been thrown on the cause of the City darkness. That wonderful lamp in the office of *Lightning* with *a nominal resistance of 95 volts* is enough to upset a bigger station than Bankside. If the lamp had a resistance of 25 C.P., or a C.P. of 95 volts, one could understand it, but, as Mr. Garcke says, we all like *Lightning*, for it prefers to be funny rather than serious.

Is the Hypothesis of Electrolytic Dissociation Superfluous?—This subject has engaged the attention of Isidor Traube for several years, and he now considers that he has acquired sufficient data to answer the question in the affirmative. Three years ago Traube showed (*vide Zeitschrift für Anorganische Chemie*, 1895, viii., page 323), that the equivalent of any ion exercises always the same attraction for the water, and that this attraction is equal to that exercised by the molecule of any non-dissociated substance, the contraction caused by this attraction being for the gram-equivalent or molecule 12·2 cc. As equivalent quantities of different ions have all the same attraction for the solvent, their osmotic pressures must be the same. Therefore, laws analogous to those of Boyle, Gay-Lussac, and Avogadro must hold for the osmotic pressure. When the electrolyte is dissolved in water, the same attraction that may be looked on as the cause of osmotic pressure also caused the weakening of the hold of the ions on one another. The law that equivalent amounts of the different ions produce on being dissolved in water, the same contraction in volume, may be compared to Faraday's law that equivalent amounts of the different ions require for their separation the same quantity of electricity. Drude and Nernst regard the electrical charging of the ions as the cause of the volume contraction (*Zeitschrift für Physikalische Chemie*, xv., 79). The analogy between the volume law and Faraday's law is, however, rather proof that the ions in solution are not electrically charged and only become so at the moment of their separation, the charging of the ions being the consequence and not the cause of the colume contraction, space energy being thus converted into electrical energy. Traube has now published a paper in the *Berichte der deutschen chemischen Gesellschaft*, 1898, Vol. xxxi., page 154, in which he confirms his conclusion that the contraction which occurs when a substance is dissolved in water is proportional to the concentration of the solution and is almost independent of the nature of the dissolved substance. The contraction is about 13·5 cc. for every dissolved gram-molecule of a non-electrolyte or for every dissolved gram ion of an electrolyte. It is thought that the contraction in aqueous solutions is due to the strong attraction between the solvent and the dissolved substance, and this leads to the hypothesis of union (changing union) between the water and the dissolved substance. The number of water particles (a) with which a given molecule of a substance in dilute solution combines is equal for all non-electrolytes, and for dissolved electrolytes increases proportionately to the number of ions. From this, Van't Hoff's conclusion, that the osmotic pressure of a solution is equal to the pressure which the dissolved substance in the form of a gas would exert at that temperature, may be deduced. In this deduction use is made of the hypothesis that a molecule of any non-electrolyte in any dilute solution at any given moment is in union with only one particle of the solvent. The author proceeds to show that his views and those of Poynting are more in accord with observed facts than are the usual views of osmotic pressure. Explanations are given for the following facts:—(1) Molecular weights, as determined in different solvents, vary; (2) colloidal substances have an osmotic pressure = 0, or nearly 0; (3) the course of any given reaction depends largely on the nature of the solvent employed (Menschutkin); (4) inversion of sugar and similar processes. The hypothesis of electrolytic dissociation, according to Arrhenius, is considered quite superfluous. The author's view is that, in dilute solutions of, say, sodium chloride, one molecule of sodium chloride is united to two of water; in concentrated solutions, to one of water.

Crystal Palace School of Practical Engineering.—The award of certificates for the winter term of 1898 took place in the lecture theatre of the school on Friday last (16th). Sir Chas. Rivers Wilson presided and addressed the students. In the course of his speech he referred to the progress of electric traction and recommended those entering the engineering profession to give special attention to this branch of it. At present, he said, in this country only 200 miles of line—railway and tramway—were worked by electricity, whereas in America there were thousands of miles. Any effort in developing the progress of electric traction in this country conferred a public benefit. He urged the students to make the best use of their time and opportunities.

Alternating Current Meter Patents.—The New York *Electrical Engineer* says that in three suits brought by the Westinghouse and Thomson-Houston Companies *v.* The Citizens' Electric Company of Brooklyn, in the United States Circuit Court for the Eastern District of New York, decrees have been entered against the Citizens' Electric Company, enjoining them from the use of alternating current meters manufactured by the Diamond Electric Company. The patents in suit are numbered 448,894, issued to Elihu Thomson; 511,559 and 511,560, issued to Nikola Tesla; and 386,003 and 386,004, issued to O. B. Shallenberger. The two Tesla patents mentioned above are two of the broad patents on split phase motors and apply to certain forms of fan motors. The two Shallenberger patents relate to that inventor's meter.

NEW COMPANIES REGISTERED.

Electric Tested Lamp Company, Limited (59,877).—This company was registered on December 10th, with a capital of £2,000 in £1 shares, to acquire and carry on the business carried on by Richard T. Godman, at 15, Victoria Street, Westminster, under the style of "The Electric Lamp Contract Renewal Company," and to adopt agreements with R. T. Godman, A. W. Gattie, and A. G. Seaman. The first subscribers (each with one share) are:—Charles H. Cumberland, solicitor, and Wm. J. Williams, clerk, both of 36, John Street, Bedford Row, W.C.; Richard T. Godman, 5, Upper Belgrave Street, S.W., gentleman; Alfred W. Gattie, dramatist, and Arthur G. Seaman, electrical engineer, both of 37, Sinclair Road, West Kensington; Wm. Smith, 1, Arthur Villas, Mill Road, Epsom, accountant; Harry St. Yorke, 53, Barmouth Road, Wandsworth, clerk. Registered without articles of association.

P. C. Middleton & Co., Limited (4,077).—This company was registered in Edinburgh on December 9th, with a capital of £50,000, in £1 shares, to acquire and carry on the business of "P. C. Middleton & Co.," electric light and power engineers, of Aberdeen, Edinburgh, and Inverness. The first subscribers (each with one share) are P. C. Middleton, Elstree, Forest Road, Aberdeen, electrical engineer; James Webster, Aberdeen, accountant; Norman Beves, 8, Brendon Terrace, Edinburgh, engineer; Wm. Smith, Schoolhill, Aberdeen, engineer; John Packman, 17, Richmond Terrace, Aberdeen, cashier; John Henderson, 14, Mount Street, Aberdeen, clerk; John Morrison, 60, Powis Place, Aberdeen, clerk. The first directors are William Jackson, P. C. Middleton, Norman Beves, J. Webster, J. Linney, and H. Skipworth; qualification, 500 shares; remuneration as the company may determine; P. C. Middleton is to act as managing director with £400 per annum. Registered office, 6, Schoolhill, Aberdeen.

Chamberlain & Hookham, Limited (59,920).—This company was registered on December 15th, with a capital of £100,000 in £5 shares, to acquire and take over as a going concern the business now carried on at Bartholomew Street, Birmingham, and elsewhere, under the style or firm of "Chamberlain & Hookham, Limited," to enter into an agreement with the said company and Joshua Brown, its liquidator, and to carry on the business of manufacturers of, and dealers in, electricity meters, electrical plant, machinery and apparatus, electrical engineers, suppliers of electricity, iron, steel, and brass workers, &c. The first subscribers (each with one share) are:—Arthur Chamberlain, J.P., Moor Green Hall, Birmingham; John S. Nettlefold, J.P., Beechenhurst, Selly Hill, Birmingham; Miss Helen Chamberlain, Moor Green Hall, Birmingham; Philip Hookham, King's Norton, Worcestershire, manufacturer; Frederic Hookham, Hampton, Malvern, Worcestershire, gentleman; Richard P. Hookham, Noke Rectory, Islip, Oxford, gentleman; and Mrs. Margaret Nettlefold, Beechenhurst, Selly Hill, Birmingham. The first directors (to number not less than two nor more than seven) are Arthur Chamberlain and George Hookham; qualification, 100 shares; remuneration, 10 per cent. of the net profits available for dividend (with a minimum of £500 per annum), divided between them.

E. J. Clark, Limited (59,953).—This company was registered on December 17th, with a capital or £2,000 in £1 shares, to acquire the business carried on as "Tizzard & Co." at Broad Street, Hanley, Staffs., to adopt an agreement with Dennis D. Butters, and to carry on the business of electricians, electrical and general engineers, machinists, oil merchants, cycle makers, &c. The first subscribers (each with one share) are:—Thomas Sherwin, 6, Harding Road, Hanley, clerk; Frederick Futrell, 120, Broad Street, Hanley, electrical engineer; Wm. A. Cowlishaw, Basford, Stoke-on-Trent, manager; Edward H. Cowlishaw, 8, Waterloo Terrace, Newcastle-under-Lyme, wine and spirit agent; Hubert T. Heatley, Basford, Stoke-on-Trent, bank accountant; John Hill, tailor, and Miss Louise Hill, Newcastle-under-Lyme. The first directors (to number not less than three nor more than seven) are to be nominated by the subscribers; qualification, £50; remuneration as fixed by the company.

Engineering Undertakings, Limited (59,897).—This company was registered on December 13th, with a capital of £5,000 in £1 shares (of which 4,500 are 5 per cent. cumulative preference), to carry on at Manchester and elsewhere the business of mechanical and general engineers, machinists, electricians, and suppliers of electricity for the purposes of light, heat, motive power or otherwise. The first subscribers (each with one share) are:—Thomas E. Kay, 18, Luke Street, Cheetham, Manchester, accountant; Albert E. Tanner, 579, Stretford Road, Manchester, engineer; George Broughall, 20, Clifford Street, Chorlton-on-Medlock, Manchester, engineer; W. John Herring, Mauldreth Road, Withington, manager; Edward E. Johnson, 78, King Street, Manchester, accountant; E. Booth Edwards, 17, Stretford Road, Manchester, chartered accountant; and Henry S. Johnson, 4, Fulwood Terrace, Old Trafford, Manchester, accountant. The first directors (to number not less than two nor more than five) are to be nominated by the subscribers; qualification, 100 shares. Registered office, 78, King Street, Manchester.

Scarborough District Lighting Company, Limited (59,906).—This company was registered on December 14th, with a capital of £5,000 in £1 shares, to manufacture, sell, and supply light in the villages of Ayton, Burniston, Cayton, Cloughton, Scalby, Seamer, Thornton Dale, and elsewhere in Yorkshire, and to carry on the business of a gasworks and lighting company, electricians, suppliers of electricity, manufacturers of electrical apparatus, mechanical engineers, &c. The subscribers are:—William Hardcastle, Church Becks, Scalby, gentleman (five shares); Valentine Fowles, St. Oswalds, Scalby, estate agent (five shares); W. Morgan, The Valley, Scarborough, managing director (one share); Frederic Pope, Sinnington, Yorks, gentleman (10 shares); Richard W. Harrison, Villa Montresa Scalby, decorator (five shares); Thomas Frank, Dennis House, Pickering, timber merchant (five shares); and Richard Clarke, 38, Londesborough Road, Scarborough, gentleman (five shares). Table "A" mainly applies.

Clayton Engineering and Electrical Construction Company, Limited (59,913).—This company was registered on December 14th, with a capital of £40,000 in £1 shares (of which 20,000 are 6 per cent. cumulative preference), to acquire and take over as a going concern the business of the Clayton Foundry Company, Limited, of Clayton, near Manchester, to enter into an agreement with the said company, and to carry on the business of mechanical and electrical engineers, millwrights, engine, dynamo and motor builders, rubber and cotton machinery designers and builders, iron, steel and brass founders, contractors, &c. The first subscribers (each with one share) are:—Joseph P. Bedson, Parkhurst, Middlesbrough, engineer; Tom Westgarth, 6, Lothian Road, Middlesbrough, engineer; Reginald Le Neve Foster, Harrytown Hall, Bredbury, manufacturing chemist; George Garner, Octagon House, Fairfield, Manchester, engineer; James H. Nuttall, 497, Edge Lane, Droylsden, engineer; Joseph R. Garner, Octagon House, Fairfield, Manchester, electrical engineer; Charles J. E Hall, Disley, Cheshire, gentleman. The first directors (to number not less than three nor more than five) are E. J. Byrne, R. Le Neve Foster, Joseph P. Bedson and George Garner; qualification, £250; remuneration, £450 per annum, divided between them. Registered office, Clayton, Manchester.

Whiteinch Galvanising Company, Limited (4,088).—This company was registered at Edinburgh on December 17th, with a capital of £15,000 in £1 shares, to carry on the business of galvanisers, engineers, iron and brass founders, electricians, &c. The first subscribers (each with one share) are:—Robert Lee, 158, Milton Street, Glasgow, engineer; Robert Young, 39, West Campbell Street, iron merchant; Colin Scott, 94, Hope Street, Glasgow, ship agent; Patrick Inglis, 64, Horrock Street, Glasgow, engineer; William Macmillan, Pointhouse Shipyard, Glasgow, shipbuilder; Alex. Wood, Woodlands, Partick, manufacturer; and Charles Connell, Balshagray Avenue, Partick, shipbuilder. The first directors (to number not more than four) are Robert Young, William Broadfoot, and John Reid. Remuneration as the company may decide; qualification, five shares. Registered office, 107, Buchanan Street, Glasgow.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Mather & Platt, Limited (36,368).—This company's annual return was filed on November 22nd, when 15,000 shares were taken up out of a capital of £200,000 in £10 shares; £9 per share has been called and £135,000 received.

Electrical Development and Finance Corporation, Limited (49,021).—This company's annual return was filed on September 20th, when 10,477 ordinary and 10,000 deferred shares were taken up out of a capital of £500,000 in £1 shares (of which 10,000 are deferred). All the deferred are considered as paid, and 15s. per share has been called on the others; £7,819 10s. has been paid and £38 5s. is in arrears.

Penny-in-the-Slot Electricity Supply Syndicate, Limited (52,304).—This company's registered office has been removed to Bartholomew Works, end of Lawford Road, Kentish Town, London, N.W.

CITY NOTES.

Aron Electricity Meter.

The first ordinary general meeting of the Aron Electricity Meter, Limited, was held on Tuesday at Winchester House, under the presidency of Sir James Pender.

The Chairman said: Gentlemen,—This meeting, as you are aware, has been called for the purpose of complying with the provisions of the Joint Stock Companies Acts. Before proceeding with the business, I wish to mention that the directors regret to inform the shareholders that, on account of the serious illness of one of their colleagues, Mr. Byng, in October last, Mr. Hugo Hirst, his partner, consented to join the board. As only some nine weeks have elapsed since the company was brought under the notice of the public, we are not yet in a position to report anything definite as to the results obtained by the transfer of Dr. Aron's business into our hands. Satisfactory arrangements have been arrived at for the gradual taking over of the business from Dr. Aron, as the purchase money could only be paid as the calls on the shares fell due; but this is a mere matter of detail, and is being satisfactorily carried out. Upon the directors taking over the business, they instructed Messrs. Price, Waterhouse and Co., to send one of their representatives to Berlin, for the purpose of reorganising the books, so as to comply with the practice usual with English companies, for, although the present system was suitable for a private business, it would not have enabled the company to watch in London, week by week, the progress of a business the bulk of which is done in Berlin and Vienna, and would not have enabled the directors to place before the shareholders a yearly balance-sheet within a reasonable time after the close of the financial year. This representative has now returned to London, having completed his object. The business which has been done during the last 11 months has exceeded expectations. For instance, we are informed by Dr. Aron and Dr. Juttke, our managing directors, that the business on the Continent has kept up its normal steady increase, about 14,000 meters having been ordered during the last 11 months, in comparison with about 11,000 during the preceding year, and the sales in England have risen from about 400 in 1897, to over 1,800 for the first 11 months of this year. The most gratifying feature of this increase does not lie in the number of meters sold, but in the fact that they have been placed with about 40 different central stations and other users, all of whom are beginning to give us repeat orders, which lead us to believe that a rapid development of the business and much larger sales may be looked for during the next year. The remarkable progress of the business in England will, no doubt, lead very shortly to a considerable number of inquiries and orders from the colonies, which will then become an additional source of income. In countries where high duties prevent us from doing a large business your directors propose to work the patents by means of separate companies. Offers from one important country are at present being considered by the directors. In Germany and Austria, where Dr. Aron's name enjoys a very high reputation, and adds considerably to the goodwill of the business, the directors propose to make arrangements so as to enable them to trade in those countries under that name. You are aware that the profits derived from the business from January 1st this year belong to this company, but, as the company only work the business on their own account from October 1st last, the profits resulting from the working from January 1st to September 30th will go towards and considerably increase the working capital of £45,000 set aside for this purpose, as mentioned in the prospectus. The profits made from October 1st will go towards future dividends, and, without taking into account the economies which we propose to introduce, and assuming that the business maintains its natural increase, we have reasonable hopes that the preference shares may at a much earlier date than we expected participate in the surplus profits after 10 per cent. has been paid on the ordinary shares. I do not think there is anything further for me to add at this meeting, except, perhaps, that we hope to pay an interim dividend on the shares on April 1st next, and the final dividend as soon as the accounts and balance-sheets have been prepared—that is to say, as soon after October 1st as is practicable. As you will thoroughly understand, we have had control of the company for such a short time that I cannot give you very much information. I have given you as much as I possibly can. When we next meet and we have been over to see our works we shall be able to give you a great deal more information than we are able to at present.

After sundry questions the proceedings terminated.

Smithfield Markets Electric Supply Company.

The report of the directors of the Smithfield Markets Electric Supply Company, Limited, with accounts for the first year of working, ended September 30th last, to be submitted to the general meet-

ing to be held in London on Friday, states that the trading account shows a profit of £759. The directors found it necessary at the outset to discontinue the method of charging by "lump sum" contracts which had previously been in force (and which had led in a great many cases to extravagant use of the current), and to adopt the customary fixed rate per unit, based on the actual meter consumption. They also found that there were numerous complaints of unequal pressure and unsteadiness of light. They much regret to report that the effect of this necessary change was a loss on trading for several months. They are, however, satisfied that their policy was correct and necessary in order to establish the company's business upon a sound basis. A substantial increase in the price obtained per unit has been effected, and, notwithstanding the loss referred to, the total number of customers now connected shows a net gain upon the number connected at the commencement of the company's operations. The price charged per unit is still below that of any other London supply company. The directors are pleased to be able to report that there is now every indication of a return of the popularity of electricity as an illuminant in the Corporation markets, and that the company's business is steadily gaining ground. There is within the markets area a large scope for an increased sale of current, which the directors are confident will be gradually acquired. Under the advice of the company's consulting engineer, Mr. V. B. D. Cooper, many important alterations and improvements have been carried out in connection with the generating plant and machinery, and substantial economies have been effected. The full benefit of these will, however, only be apparent in the result of the next year's working. The staff has been to a large extent reorganised, and Mr. Eustace Ridley, who held the position of assistant engineer to the St. James's and Pall Mall Electric Light Company, Limited, has been engaged as chief engineer in charge of the station. Mr. G. M. Powell, who has had special experience to qualify him for the position, has been engaged as secretary to the company. These appointments were made by the directors after the most careful consideration, and they have pleasure in expressing their satisfaction with the results. The working of the station and the conduct of the company's business has been carried on in a satisfactory manner. All complaints of inequality of the light have ceased. The cost of production has been substantially reduced, and when the installation of the large storage battery (with a capacity of 2,000 ampere-hours), now on order, has been completed, the cost per unit will be still further reduced to a figure with which only companies with a very much greater output can compare. The directors are pleased to report that the improvement in the company's business since the initial difficulties and disappointments have been overcome is so marked, that a careful estimate of the results of the working of the present quarter, based upon the meter readings to December 10th, shows that the gross profit earned in this quarter will be at least £800, or more than the total profit for the whole of the previous year. The working expenses may now be taken as being upon a minimum basis, and a very large additional amount of current could be generated and supplied at a comparatively small extra cost. As the tendency is in the direction of increased demand, and as there is a very large scope for increase of business in the Corporation markets alone, the directors are confident that the company will be upon a dividend-earning basis in the second year of its operations. Applications have been made to the Board of Trade for provisional orders empowering the company to supply electric current in the areas of the City of London, the parish of St. Luke, Middlesex (which includes Finsbury and a portion of Moorgate Street) and the Holborn district. All of these three areas immediately adjoin the company's generating station being centrally situated between them. The directors are using their utmost endeavours to ensure the successful result of their applications, and are engaged in negotiations in respect of important extensions of the scope of the company's operations to which at present they do not deem it expedient to refer in detail. Satisfactory progress has been made, and there is reason to hope that substantial benefits will accrue therefrom. The result of the applications for provisional orders will be known the first six months of 1899. The chairman, Mr. G. H. Brougham Glasier, has been regretfully obliged to resign his seat on the board, owing to the fact that the Charing Cross and Strand Electricity Supply Company, of which he is also the chairman, has made an application (in competition with this company) for a provisional order for the electric lighting of the City of London. The remaining two directors much regret that under the circumstances they had no alternative but to accept his resignation. Until the result of the applications now before the Board of Trade shall have been made known, they have not considered it necessary nor desirable to take any steps to appoint a new director. The directors have, by a resolution, waived any claim to payment of their fees, now or at any future date, in respect of the past year.

PROFIT AND LOSS ACCOUNT, year ending September 30th, 1898.

Dr.	£	s.	d.
1. To Interest on 4 per cent. debenture stock, paid and accrued	1,449	14	3
2. „ Proportion of preliminary expenses	136	15	4
3. „ Trustees' fees	25	0	0
4. „ Interest on deposit accrued	310	13	8
	£1,922	3	3

Cr.	£	s.	d.
1. By Balance from trading account No. 2	759	3	1
2. „ Interests on deposit	386	3	8
3. „ Interest on calls	1	15	8
4. „ Balance carried to general balance-sheet	775	0	10
	£1,922	3	3

Britannia Motor Carriage Company.

AN extraordinary general meeting of the Britannia Motor Carriage Company, Limited, was held on Monday last at the Holborn Restaurant, W.C., for the purpose of passing the following special resolutions:—"(1) That an agreement dated December 9th, 1898, between the London Exploration Company, Limited, of the one part and the Britannia Motor Carriage Company, Limited, of the other part, which has been provisionally signed on behalf of the company by its directors, and which is an agreement for the sale by the company of the whole of its undertakings and assets, be and it hereby is approved and adopted. (2) That the company be wound up voluntarily under the provisions of the Companies Acts, 1862 to 1897, and that Hon. J. H. H. Berkeley, of Throgmorton House, in the City of London, be and he hereby is appointed liquidator for the purpose of such winding-up." The Hon. J. H. H. Berkeley (chairman of the company) presided, and after explaining the position of the company the resolutions were accepted.

Stock Exchange Notices.—The Stock Exchange Committee have (1) appointed special settling days as under:—Thursday, December 29th.—Callender's Cable and Construction Company, Limited—7,440 5 per cent. cumulative preference shares of £5 each, £3 paid, and 12,560 5 per cent. cumulative preference shares of £5 each, fully paid, within Nos. 1 to 20,000; Great Northern and City Railway Company—78,000 4 per cent. preferred ordinary or Class A shares of £10 each, £2 paid, Nos. 1 to 78,000; Metropolitan Electric Supply Company, Limited—further issue of 22,500 ordinary shares of £10 each, £4 paid, Nos. 62,501 to 85,000. And (2) ordered the under-mentioned securities to be quoted in the Official List:—Great Northern and City Railway Company—78,000 4 per cent. preferred ordinary or Class A shares of £10 each, £2 paid, Nos. 1 to 78.000; London Electric Supply Corporation, Limited—£100,000 4 per cent. first mortgage debenture stock; Metropolitan Electric Supply Company, Limited—further issue of 22,500 ordinary shares of £10 each, £4 paid, Nos. 62,501 to 85,000; and a further issue of 100 ordinary shares of £10 each, fully paid, Nos. 1 to 100.

National Telephone Company.—The transfer books of the 3½ per cent. debenture stock of the National Telephone Company, Limited, will be closed from 19th to 31st inst. inclusive, for the preparation of the warrants for the half year's interest due January 1st.

The Pacific and European Telegraph Company, Limited.—The coupons on 4 per cent. guaranteed debentures, due 31st inst., will be paid on and after that date at Parr's Bank, Limited, Bartholomew Lane, London, E.C.

Sheffield Electric Light and Power Company.—An extraordinary general meeting of the shareholders in this company was held on Tuesday at the Cutlers' Hall, to declare a dividend for the past year, and to order that the company be wound up voluntarily. A resolution to this effect was adopted.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending December 17th, 1898, were £139 4s. 11d.; aggregate to date, £14,126 8s. 10d.

The Bradford City Tramways.—Week ending December 18th, 1898, miles of track open, road mileage, 4·72; number of cars, 16. Receipts, £241 3s.; total receipts to date, £923 7s.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending December 16th, 1898, were £2,550 0s. 3d.; corresponding period, 1897, £2,362 13s. 4d.; increase, £187 6s. 11d.

The City and South London Railway Company.—The receipts for the week ending December 18th, 1898, were £1,080; week ending December 19th, 1897, £1,080; total receipts for half-year, 1898, £24,834; corresponding period, 1897, £24,062; increase, £772. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week, ending December 17th, 1898, were £189 11s. 5d.; week ending December 18th, 1897, £109 13s. 7d.; increase, £29 17s. 10d.; total receipts to date, 1898, £8,209 3s. Miles of track open week ending December 17th, 1898, 3; week ending December 18th, 1897, 3. Car miles run week ending December 17th, 1898, 4,310; week ending December 18th, 1897, 2,352. Number of cars week ending December 17th, 1898, 11; week ending December 18th, 1897, 7.

The Dublin United Tramways Company.—The receipts for the week ending Friday, December 16th, 1898, were as follows:—D. U. T. Co., horse cars, £2,132 15s. 8d.; ditto, electric cars, £565 18s. 4d.; D. S. D. Co., electric cars, £622 10s. 8d.; total, £3,321 4s. 8d; corresponding week last year—D. U. T. Co., horse cars, £2 589 8s. 6d.; ditto, electric cars, £105 1s. 6d.; D. S. D. Co., electric cars, £357 14s. 5d.; total, £3,052 4s. 5d.; increase, £269 0s. 3d.; aggregate to date, £95,364 7s. 3d.; aggregate to date last year, £88,362 17s. 10d.; increase to date, £7,001 9s. 5d. Worked:—The mileage open is 16 miles electrically, 28 miles by horses, as against 11 miles electrically, and 31 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways. — The receipts for the week ending December 14th, 1898, were £235; total receipts to date, 1898, from June 29th, 1898, £6,302. Miles of track open, 3½. Car miles run, 4,088. Number of cars, 10.

The Liverpool Overhead Railway Company.—The receipts for the week ending December 18th, 1898, amounted to £1,324; corresponding week last year, £1,342: decrease, £18.

The South Staffordshire Tramways Company.—The receipts for the week ending December 18th, 1898, were £603 4s.; week ending December 17th, 1897, £565 2s. 2d.; aggregate receipts for 50 weeks, £31,552 17s. 8d.; last year, £31,541 3s. 6d.

The Western and Brazilian Telegraph Company, Limited.—The receipts for the week ending December 16th, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,962.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, Dec. 14th.	Closing Quotation, Dec. 21st.	Business done during week ended Dec. 21st, 1898. Highest.	Lowest.
127,400*l*	African Direct Telegraph, 4 % Debs.	100	4 %	...	...	101 —105	101 —105	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	92 — 95	92 — 95	...	...
905,560*l*	Anglo-American Telegraph	Stock	£2 9s	£2 13s	3 %	64 — 67	64 — 67	66	64½
3,047,220*l*	Do. do. 6 % Pref.	Stock	£4 18s	£5 6s	6 %	115 —116	115 —116	116½	115⅝
3,047,220*l*	Do. do. Deferred...	Stock	...	...	...	16½ — 17	16 — 16½	17	16⅛
130,000	Brazilian Submarine Telegraph	10	7 %	7 %	7 %	15¼— 15⅜	15¼— 15⅜	15⅜	15⅛
75,000*l*	Do. do. 5 % Debs. 2nd series, 1906 ...	100	5 %	...	...	111 —115	111 —115	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	4 %	2¾— 3¼	2¾— 3¼	...	...
10,000,000$	Commercial Cable	$100	7 %	8 %	8 %	180 —190	180 —190	...	...
918,297*l*	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105¼	103¼
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½ %	2 %	...	1/16 — 3/16	1/16 — 3/16	...	...
16,000	Cuba Telegraph	10	8 %	8 %	7 %	10 — 11	10 — 11	10½	10¼
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	16½— 17½	16½— 17½	...	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	...	...
30,000*l*	Do. do. 4½ % Debs., Nos. 1 to 6,000 ...	50	4½ %	4½ %	4½ %	105 —108%	105 —108%	...	...
60,710*l*	Direct United States Cable	20	2¼%	2½%	...	11½— 12	11½— 12	11⅞	11¹³/₁₆
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	103 —106	103 —106	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	...	...	...	172 —177	173 —178	176	173⅛
1,295,000	Do. 3½% Pref. Stock	100	...	...	...	104 —107	104 —107	105¾	104½
500,000	Do. Prov. Certs., 50 % paid	...	...	...	...	54 — 57	54 — 57	...	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	5 %	101 —104	101 —104	...	...
1,432,268*l*	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	124 —128	124 —128	124	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	17¼— 17¾	17½— 18	17⅛	17⅜
16,200*l*	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	5 %	101 —105	101 —105	...	...
64,400*l*	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	5 %	102 —105	102 —105	...	...
320,000*l*	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	125 —129	125 —129	125¼	...
35,100*l*	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	101 —105	101 —105	...	...
46,500*l*	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	102 —105	102 —105	...	...
300,000*l*	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	103 —106	104 —106	...	...
200,000*l*	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	4 %	...	103 —106%	104 —107%	104	...
180,227	Globe Telegraph and Trust	10	4⅛%	4½%	4½%	12¼— 12¾	12¼— 12¾	12¼	12⅝
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	16¾— 17¼	16¾— 17¼	16⅞	16¹³/₁₆
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	10 %	28½— 29½	28½— 29½	...	...
150,000*l*	Do. do. do. do. 5 % Debs. ...	100	5 %	5 %	5 %	100 —103	100 —103	...	...
97,800	Halifax & Bermuda Cable, 4½% 1st. Mt. Dbs., w'n. 1-1,200, rd.	100	...	...	...	101 —104	101 —104	101	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	54 —57	55 — 58	57	56¾
100,000*l*	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	6 %	109 —112	109 —112	...	...
484,597	National Telephone, 1 to 484,597	5	5½%	5½%	6 %	5½— 5¾	5½— 5¼	5¾	5⅝
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5½	5¼— 5½	5½	...
1,329,471*l*	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	100 —103	100 —103	100½	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅝— ¾	⅝— ¾	...	...
100,000*l*	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	4 %	105 —108	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	7	...
3,381	Submarine Cables Trust	Cert.	...	...	...	134 —139	134 —139	140	...
58,000	United River Plate Telephone	5	4 %	5 %	6 %	4¼— 4¾	4¼— 4¾	...	...
151,733*l*	Do. do. 5 % Debs.	Stock	5 %	...	...	104 —107	104 —107	...	...
200,000*l*	West African Telegraph, 5 % Debs.	100	5 %	5 %	5 %	99 —102	100 —103	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ⅜	¼— ⅜	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	103 —106	103 —106	...	...
64,269	Western and Brazilian Telegraph	15	3 %	2 %	3½%	12¼— 12⅜	12¼— 12⅜	...	...
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	8 — 8¼	8 — 8¼	...	...
33,129	Do. do. do. Def. Ord.	7½	1 %	nil	½%	4 — 4½	4 — 4½	...	...
389,521	Do. do. do. 4 % Deb. Stock Red. ...	Stock	...	...	...	107 —110	107 —110	...	...
88,321	West India and Panama Telegraph	10	⅝%	1 %	⅝%	1¼— 1½	1⅝— 1⅞xd	1¹¹/₁₆	1⁵/₁₆
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	6 %	9¾— 10¼	10 — 10½xd	10¼	9¾
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	6 %	7 — 9	8½— 9½xd	8½	...
80,000*l*	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	106 —109	106 —109	...	...
158,100*l*	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	6 %	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	5 %	6 %	7 %	11½— 12½	11½— 12½	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	5 %	6 %	8½— 9½	9 — 10	9 1/16	9¼
60,000	Do. do. do. 4½ % Deb. Stock Red....	Stock	4½%	4½%	4½%	115 —117	113 —115 xd	...	...
50,000	City of London Electric Lighting, Ord. 40,001—90,000 ...	10	5 %	7 %	10 %	24 — 25	22 — 24	24⅜	21
10,000	Do. Ord. Nos. 90,001 to 100,000	10	...	...	...	23½— 24½	21 — 23	22	21¾
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15½— 16½	15½— 16½	15¾	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	127 —132	127 — 132	128	127½
30,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000	10	nil	nil	nil	12½— 13⅛	12½— 13⅛	...	...
10,000	Do. do. do. Nos. 30,001 to 40,000 £8 paid.	10	...	...	...	10 — 11	10 — 11	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14½— 15½	14½— 15½	...	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	...	5 %	5 — 5⅛	5 — 5⅛	5⅛	...
15,661	House-to-House Electric Light Supply, Ord., 101 to 15,761	5	...	...	4 %	9 — 10	9 — 10	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	7 %	9½— 10½	9½— 10½	9 1/16	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3¼— 3⅜	3 — 3½	3⅜	...
48,050	Do. do. do. 6 % Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
62,400	*Metropolitan Electric Supply, 101 to 62,500	10	4 %	5 %	6 %	17½— 18½	17½— 18½	19 1/16	17¾
220,000*l*	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	4½%	117 —121	117 —121	118½	...
6,452	Notting Hill Electric Lighting	10	2 %	4 %	6 %	16½— 17½	17 — 18	17⅝	17½
31,980	*St. James's and Pall Mall Electric Light, Ord.	5	7½%	10½%	14½%	16 — 17	16 — 17	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
50,000	Do. do. 4 % Deb. Stock Red. ...	Stock	...	...	4 %	105 —108	105 —108	...	...
65,000	South London Electricity Supply, Ord., £3 paid	5	...	...	...	2⅞— 3⅛	2⅞— 3	2 15/16	2¾
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	7 %	9 %	12 %	16 — 17	15½— 16½	16 3/16	16

* Subject to Founder's Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation Dec. 14th.	Closing Quotation Dec. 21st.	Business done during week ended Dec. 21st, 1898. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	...	...	...	3½— 3⅝	3½— 3⅝	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	94 —100	94 —100	...	...
30,000	British Electric Traction	10	...	...	...	16 — 17	15½— 16½	16⅛	15⅞
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13 — 13½	13 — 13½	13¼	13 1/16
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	2½%	*nil*	*nil*	1⅝— 2	1⅝— 1⅞	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	*nil*	4 %	2⅜— 2⅝	2⅜— 2⅝	2 3/16	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	111 —115	111 —115	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	102 —105	102 —105	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	...	...	...	9½— 10½	9½— 10½	...	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	111 —114	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	9¾— 10¼	9¾— 10¼	10⅛	10
178,303	Do. do. do. £6 paid	10	...	...	...	5¾— 6¼	5¾— 6¼	5⅞	...
61,033	Do. do. Pref. half-shares £1 paid ...	...	...	...	...	1¼— 1⅜	1¼— 1⅜	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	4¼— 4¾	4¼— 4¾	...	...
630,000*l*	City and South London Railway	Stock	1 3/16 %	1 9/16 %	1⅞ %	65 — 68	65 — 68	...	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £4 pd.	10	...	...	...	3½— 4	3½— 4	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	1¾— 2¼	1¾— 2¼	...	...
82,850	Do. 5% 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red.	...	...	...	...	91 — 96	91 — 96	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5 %	5⅓%	6 %	2 — 2⅛	2¼— 2⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5 %	5⅓%	6 %	4 — 5	4 — 5	...	...
194,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	99 —101	97 — 99xd	...	...
110,000	Electric Construction, 1 to 110,000	2	5 %	6 %	6 %	2¼— 2⅜	2¼— 2⅜	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	2⅜— 3⅛	2⅜— 3⅛	...	...
111,100	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	105 —107	105 —107	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	¼— ½	¼— ½	...	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	¼— ½	¼— ½	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	10½%	7 %	7 %	10 — 12	10 — 12	...	...
12,500	Henley's (W. T.) Telegraph Works, Ord.	10	8 %	10 %	12 %	20½— 21½	21½— 22½	22¼	21⅝
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18 — 19	18 — 19	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	4½%	110 —115	110 —115	113	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21½— 22½	21½— 22½	22⅜	22
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞%	2⅞%	3½%	10 1/16— 10 3/16	10 1/16— 10 3/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	14¾— 15¼	14¾— 15¼	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	...	...
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	104 —107	104 —107	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	...	112 —115	111 —114	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10⅛.
British Aluminium, Ordinary, 10—12; 7 % Pref., 11—13.
House-to-House, 4½% Debentures of £100, 108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 13—14; 1st Preference Cumulative 6%, £5 (fully paid), 7¾—8¼. Debentures, 107—110. Dividend, 1897, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, ⅜ to ½.
Smithfield Market Electric, 2—4.
*T. Parker, £10 (fully paid), 15½.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (October 13th, 1898).

MARKET QUOTATIONS, Wednesday, December 21st.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	32/-	32/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per ton	37/-	37/-	..
a Ammonia, Muriate (grey) .. per ton	£19	£19	..
a „ „ (white) .. per ton	£26	£26	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£19 10	£19 10	..
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a „ White Sugar .. .. per ton	£30 10	£30 10	..
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3½d.	3½d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	65/-	65/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6 15	£6 15	..
a „ Recovered .. .. per ton	£5 15	£5 15	..
a „ Lump .. .. .. per ton	£5 5	£5 5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	3d.	3d.	..

METALS, &c.	This week.	Last week.	Increase or Decrease.
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
c Brass (rolled metal 2' to 12') basis per lb.	6¾d.	6¾d.	..
c „ Tube (brazed) .. .. per lb.	8¼d.	8¼d.	..
c „ Wire, basis .. .. per lb.	7d.	7d.	..
f Ebonite Rod .. .. .. per lb.	3/-	3/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£66	£66	..
g „ Wire (basis price) .. per lb.	8d.	8d.	..
g „ Sheet .. .. .. per ton	£66	£66	..
g „ Rod .. .. .. per ton	£66	£66	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	none obt'le
h India-rubber, Para fine .. per lb.	3/11½ forw'd	3/11½ forw'd	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	43/3	44/6	3d. dec.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	45/-	45/-	..
i „ Wire galvanised No. 8 .. per ton	£8 15	£8 15	..
g Lead, English Ingot .. .. per ton	£13 5	£13 5	..
g „ „ Sheet .. .. per ton	£14 3 9	£14 5	1/3 dec.
l Mica (uncut slabs 8" long) .. per lb.	6/6	6/6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£7 15	£7 15	..
o Platinum .. .. per oz.	£3 1 6	£3 1 6	..
i Steel, Magnet, according to description .. .. .. per ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£85 10	£85 10	..
g „ foil .. .. per lb.	1/3	1/3	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/4	1/4	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	6½d.	6½d.	..
„ Flax, 6 or 8 lea... .. per lb.	8½d.	8½d.	..
j „ Hemp, 3 ply 10 lbs. .. per lb.	8½d.	8½d.	..
j „ „ Russian, 10 lbs. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£12	£12	..
j „ Manila, 24 thread .. per ton	£29	£29	..
k Zinc, Sheet (Vielle Montagne bnd.) p. t.	£29 10	£29 10	..

a Quotations supplied by Messrs. G. Boor & Co.
b „ „ „ The British Aluminium Co., Ltd
c „ „ „ Messrs. Thos. Bolton & Sons.
d „ „ „
e „ „ „
f „ „ „ The India-Rubber, G.-P., and Teleg. Works Co Ltd
g „ „ „ Messrs. James & Shakspeare.
h „ „ „ „ Jackson & Till.
i Quotations supplied by Messrs. Bolling & Lowe.
j „ „ „ „ Henry C. Yeo & Co.
k „ „ „ „ Morris Ashby, Limited.
l „ „ „ „ Sanders, Wake & Co.
m „ „ „ „ W. T. Glover & Co., Ltd.
n „ „ „ „ P. Ormiston & Sons.
o „ „ „ „ Johnson. Matthey & Co., Ltd

INSTITUTION OF ELECTRICAL ENGINEERS.

"Electric Intercommunication in Railway Trains" By W. E. Langdon, Vice-President. Paper read December 15th, 1898.

The first practical means of communication between the passengers, guards, and the driver of a railway train was that established by Mr. W. H. Preece, C.B., F.R.S., Past-President, on the London and South-Western Railway in 1864. The agency employed was electricity.

The need for some means of communication between the passengers and the officials in charge of railway trains had been long felt. The Railway Commissioners, as well as the Board of Trade, urged its desirability. On two occasions it formed the subject of inquiry by committees of the House of Commons; and prior to 1866 no less than three committees, composed of the general managers of the various railways, had specially considered the subject. In 1865 the Board of Trade instructed Captain (now Sir Henry) Tyler, then one of the inspecting officers for the railway department of the Board of Trade, to examine and report upon the question. His report, which was issued the same year, was in favour of the establishment of "some" means of communication. In 1867 the Board again drew attention to the subject; and in 1868 an Act of Parliament made it incumbent on all railways to provide a means of communication between the passengers and the guards of every train travelling over 20 miles without stopping.

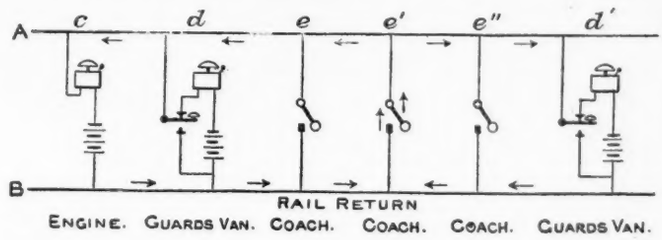


FIG. 1.

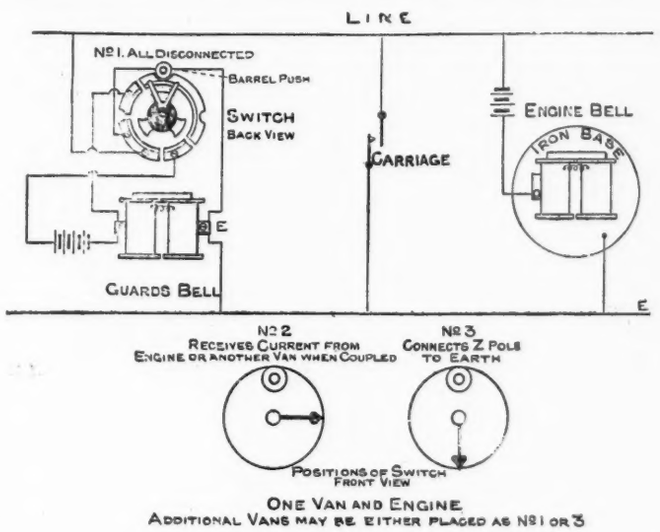


FIG. 2.

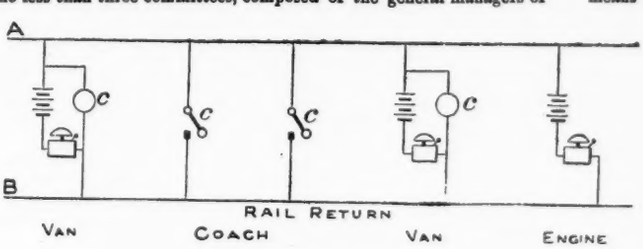


FIG. 3.

The railway companies themselves had not been indifferent to the need, for, as Mr. Preece, in a paper* read by him before the Institution of Civil Engineers in 1866, relates, the London and North-Western Railway had spent a considerable sum of money in an endeavour to establish an electrical means of communication; while experiments had also been conducted, with a like object, on the London and South-Western Railway. It was not, however, until Mr. Preece produced his system in 1864 that a satisfactory basis for effecting the long-felt need was laid down.

This was rapidly followed, on the South-Eastern Railway, by Mr. C. V. Walker, one of our first presidents, who produced that known under his name in 1866. Varley, about the same time, established an electrical form of communication on one or more London and North-Western trains. The London and South-Western fitted up several trains with Preece's system, and trial trains were also fitted with the same system on the Midland and London and North-Western. An improved mechanical "cord" system was produced about the year 1868. This "cord" is that with which every railway traveller is acquainted, and which, passing along the eaves of the vehicles, is available from the outside, and from one side only, of the train. Eventually, in 1868, the railway companies elected to employ the mechanical rather than the electrical mode of communication; and to this the Board of Trade extended conditional approval.

The South-Eastern Company declined to fall in with this decision. Recognising the advantages which an electrical means possessed over that of the mechanical cord, they desired to retain it; and in this they were subsequently† followed by the London, Brighton and South Coast Railway. Each of these companies have now their entire passenger stock fitted with an electrical communication. The London and South-Western—a company having more trains electrically fitted than any other company at the time when the "cord" system was adopted—presumably found the difficulty of keeping together a partially-fitted stock too great, and in course of time abandoned the effort.

In 1872 Captain Tyler reported the working of the "cord" system as unsatisfactory, and in the course of his remarks observed, "An electrical apparatus appears, on the whole, to offer the best chance of success." The "cord" communication has, however, been retained in use on the majority of railways; the only exceptions being the two lines previously referred to. The Hull and Barnsley (the stock of which was electrically fitted at the opening of the line in 1885), together with a portion of the stock of the Chatham and Dover Company; the Furness, Great Central, and Cambrian lines, employ to a certain extent a partial application of the vacuum brake.

In considering the action of the companies so far, we have to bear in mind the conditions associated with railway travelling at the date of the inauguration of the "cord" system. That an electrical system afforded the railway passenger a more ready means of access there could be no doubt. That the "cord" system could prove of little service in case of outrage is equally clear. But was the prevention of outrage the object of the communication? It was possibly one reason, but no doubt primarily that which was in the minds of people was the possibility of some derangement of the train. Another point for consideration is the fact that the magnitude of most of our main line trains has greatly increased. Such a means of communication might possibly serve the purpose for which it was established with a moderate number of vehicles, while its utility for a much larger number would have to be largely discounted.

However this may be, the somewhat recent outrage on the London and South-Western Railway has not only made it clear that, if this means of communication is to provide, as far as the railway companies can, against outrage, the means for operating it must be within easy reach of the passenger, but it has still further demonstrated that outrage of the direst character does not need the time occupied by a train to travel 20 miles in which to accomplish it.

The whole question has now been brought to a climax by the report‡ of the departmental committee appointed by the Board of Trade in 1897 to consider and report upon the subject. As is now well known, the result of the deliberations of this committee was the condemnation of the mechanical cord and the recommendation of an electrical system, accompanied by certain suggestions in relation thereto.

The adoption of an electrical system involves some very important considerations. The question has now to be viewed from a vastly different standpoint to that from which it has been considered hitherto. It is to be applicable to the entire passenger stock. It is desirable it should appeal against outrage as well as meet other demands. The interchange of railway stock between the various

* Preece, "On the Best Means of Communication between the Passengers, Guards, and Drivers of Trains in Motion," Institution Civil Engineers, 1866-67.

† The electrical passenger and guard communication on the Brighton line was introduced in 1874, and from that date gradually superseded the mechanical cord.

‡ See Appendix.

railway systems is now a matter of everyday occurrence; consequently the system to be adopted should have a common basis, and the mode of connecting the various vehicles should be absolutely uniform. How is this to be accomplished?

The railway companies have, practically, at this moment an open field before them. The total number of passenger traffic vehicles belonging to the entire railway service of Great Britain and Ireland amounts, exclusive of 18,099 locomotives, to 55,868*—in all, 73,967. The total stock of the three companies which have their coaches already electrically fitted comprises 5,430 vehicles and 977 locomotives; so that, if an entirely new system had to be adopted, the number of vehicles which would require modification would, in comparison to the whole, not prove very considerable; and this especially so, should the modification of the stock already fitted prove of a very simple character.

I propose to consider the question under the following heads:—

1. The electrical system.
2. Mode of connecting vehicles.
3. The means for claiming the attention of the officials in charge of the train.

1.—The Electrical System.

Fig. 1 illustrates diagrammatically the system introduced by Preece in 1864. I reproduce this because it forms the basis on which this form of communication has, in almost all cases, been framed; and it, moreover, constitutes the only basis upon which a practical form of passenger and guard communication can be established.

A is an insulated wire proceeding through the train; B represents the rails upon which the train is travelling; c is the engine; d, d', guards' vans; and e, e', e'', coaches. Each of the guards' vans is provided with a bell, battery, and a bell key. The passenger vehicles are provided, in each compartment, with a switch, or means of joining the two conductors, A and B. The batteries are, as will be observed, arranged in parallel. The condition is practically one of balanced currents. All is in tension, but until the balance is disturbed no action sufficient to operate the bells can take place. If the switch at e' is closed, we at once form this outlet, and each battery finds its circuit, as shown by the arrows. Every bell in the train is thereon set ringing, and continues to do so so long as the connection at e', or, of course, any other like connection, remains good.

The same occurs when either of the guards desires to signal to the other, or to the driver. By pressing the bell key the two conductors, A, B, are joined in precisely the same manner as when connected at e', but the guard who makes the signal, in doing so removes his own bell from the circuit.

Fig. 2 illustrates the arrangement inaugurated by Walker. Considerable modifications have been introduced by Mr. Leonard, Mr. C. V. Walker's successor, but some complication still attaches to it. One insulated wire is employed; the rails, as a rule, forming the "return," although, latterly, Mr. Leonard is supplementing the rail return by an open wire joined to the rail connections. The batteries of the two end vehicles only are in use. They are in parallel; but a three-way switch has to be provided in each van, and the guard has to arrange the switch of his van according to the position the van occupies in the train. When intermediate between the engine and another guard's van, it is so placed that his bell may ring but that his battery may be out of circuit.

Fig. 3 represents the Brighton Company's system. It is essentially Preece's. A is the insulated wire, B the rail return conductor, and c, c, c, c, are short-circuiting or connecting switches. Mr. Houghton, the company's electrical engineer, informs me that he also is now forming, by means of an open wire carried under the frame of the vehicle, a metallic return—not independent, but supplementary to the earth or rail connections. It is found that the rail "return" is not reliable, especially in very dry weather—a result which might be anticipated.

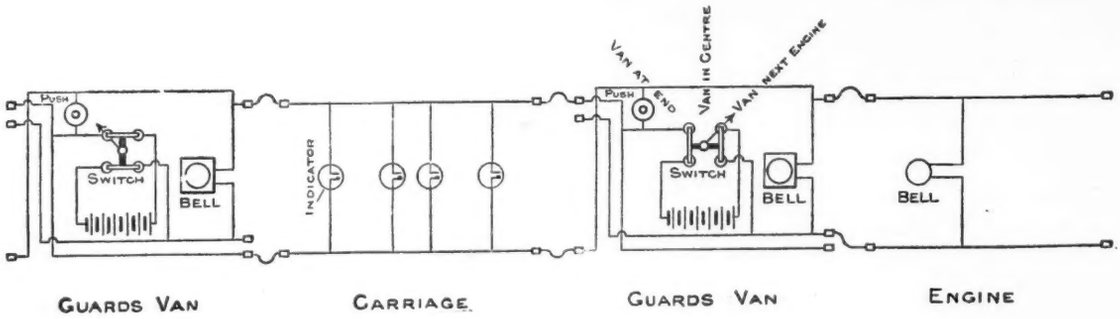


Fig. 4.

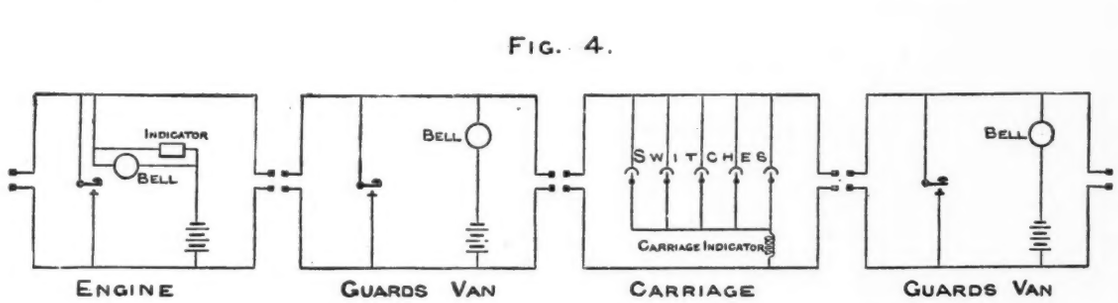


Fig. 5.

The London, Chatham, and Dover have somewhat recently applied an electrical form of communication to certain of their trains. The system is termed Varley's, but it has, at the suggestion of the company's electrical engineer, Mr. Burnham, undergone some modification. The principle now being pursued is shown in fig. 4. It is, in practice, very similar to that in use on the South-Eastern. The batteries of the two end vans are in circuit. The batteries of intermediate vans are cut out. The system is a two-wire system, both wires being insulated.

It will be observed by the diagram that the guards' vans are provided with three connections, two of which are applicable to the connection between the van and the locomotive, and that the bell in the van adjoining the engine is in parallel with that on the locomotive. This dispenses with a battery on the engine; but in order to ensure equal action on the part of the two bells, it is necessary that the *resistance* of the conductors and instruments should be fairly equal.

The system employed on the Hull and Barnsley is also a two-wire system, and the circuit arrangements call for the provision of adjusting switches in the guards' vans, in like manner to those employed on the South-Eastern and Chatham and Dover.

Considerable attention has been called to a train fitted up by the Great Eastern. The rails are not, in this system, made use of. One insulated wire passes through the train. The iron tube serving the brake is taken advantage of to form a portion of the return circuit, which is, consequently, uninsulated. The electrical arrangement is shown in fig. 5. The batteries are in parallel. The system is that of Preece, with the exception that an open "return," independent of the earth or rails, is provided.

A train has also been fitted by the Midland. The electrical system is that represented in fig. 1, with the exception that two insulated wires are employed—neither rails nor brake pipe are touched. All portions of the electrical system are protected from moisture, so that there may be no leakage.

(To be continued.)

* See Appendix, Table I.

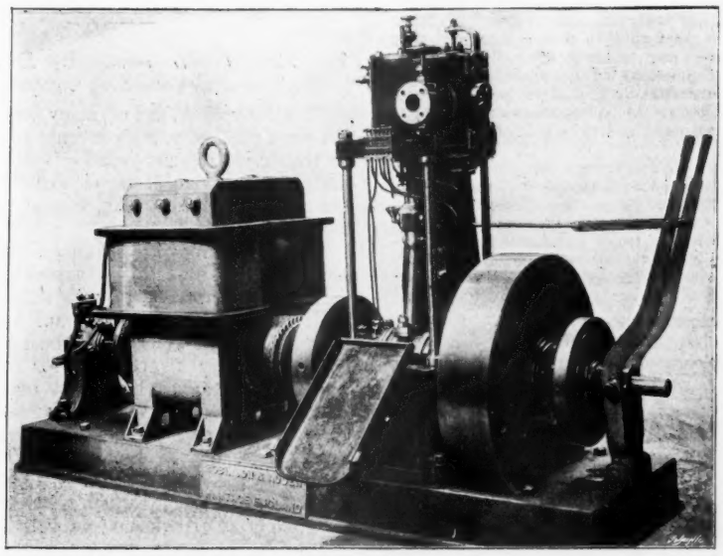
THE LIGHTING OF A FIRE STATION.

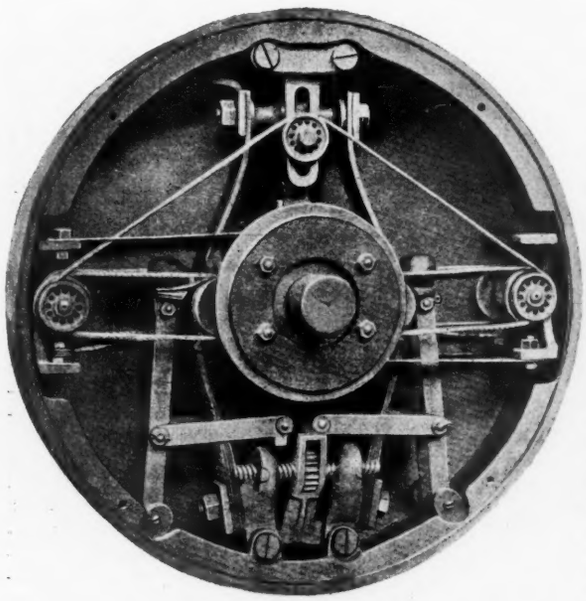
The headquarters of the Metropolitan Fire Brigade have recently been lighted with electricity, a special installation being put down by the National Electric Free Wiring Company under contract with the London County Council. We illustrate below the combined engine and dynamo, which was supplied by Messrs. Robinson and Auden, of Wantage. The normal speed of the engine is 300 revolutions, and it has a cylinder of 9½ inches diameter by 8 inches stroke.

The brake horse-power reached on trial 30, whilst the difference in speed between full and half-load suddenly thrown on and off was about three revolutions per minute. The dynamo is shunt-wound, and is suitable for an output of 100 volts, 140 amperes, with 300 revolutions, or 140 volts, 160 amperes, with 350 revolutions. The speed of the dynamo can be raised by the speeder lever 50 revolutions, *i.e.*, from 300 to 350 revolutions, whilst running. At present the lights are driven direct from the plant, as there is no battery. A special feature of the engine is that it is fitted with the firm's new form of expansion governor, shown in fig. 2. Some descriptive notes of this governor will be interesting.

A shaft, wheel or drum governor comprises mechanism contained in the fly-wheel of the engine—or in a separate wheel—the function of which is to increase or decrease the eccentricity of the slide valve eccentric as the load on the engine becomes greater or less, thus giving an earlier or later "cut-off" of the steam admitted to the piston, and so controlling the engine.

This form of governing is claimed to be applicable to the majority of steam engines, and if adopted on engines which are using steam very wastefully, and governing very badly, the Robinson governor will effect an enormous saving of fuel, in addition to ensuring perfect running, minus wear and tear. The most general form of shaft governor has been that of heavy fulcrumed weights controlled by spiral springs—which have a tendency to break or get weak in time—connected together by a jointed link; similar connections are then made from one or both weights to the eccentric, which is hinged to the wheel, and which is moved by a link, quadrant or eccentric, attached to one of the weights. These heavy weights wear their





Shaft Governor.

fulcrum pins, which are difficult to lubricate, and the connecting link pins or quadrants wear also, causing "back lash" and noise and rapid wear, with the result that, in many cases, this form of governor has of necessity been discarded to save expense, and throttle valve governing resorted to. In very many cases the stability of the equilibrium of forces at work in the governor cannot be maintained without the addition of "dashpots," "friction devices," or "locking gear," such as the quadrant attached to one of the weights, which, together with the heavily loaded weight journals or fulcrums, render the coefficient of friction in all these governors a constantly varying quantity.

In the Robinson shaft governor, which is naturally adapted for being adjusted whilst running, the advantage of being able to speed up and down, when desired, is one of the principal features, and combined with absence of spiral springs and heavy fulcrumed weights, renders it a very satisfactory form of shaft governor.

In it flat steel blades are made to take the place of spiral springs, and in addition to this there is the great advantage of the jointless parallel motion; the spring blades and this parallel motion making the connection with the eccentric, stretcher, and guide plate "positive," and so far doing away with all pin joints and journals. The completion of this ideal mechanical arrangement has been effected by the application of weights pulling directly on the spring blades by means of wire rope and pulleys. This arrangement is stated to provide practically a frictionless locking gear in constant thrust, and, in spite of the pulls and thrusts to and fro of the eccentric which drives the slide valve, with its varying resistances and many positions, the stability of forces at work in the governor cannot be upset.

This simple arrangement shows that, by the application of the principle of the reduplication of pulleys, a weight can be enabled to pull direct on a spring or springs, without wear to the pin on which it is hinged, and with any desired traverse, according to the number of pulleys introduced, a very small weight being thus rendered capable of controlling very powerful springs.

Messrs. Wilson Hartnell and J. Hardie McLean have reported upon their tests of the governor and its suitability for electric lighting engines.

PROF. ELLIOTT ON ELECTRIC TRACTION.

[COMMUNICATED.]

Prof. Elliott's paper at the Cardiff meeting of the Institute of Marine Engineers was largely a brief historical *résumé* of the progress of electrical traction, and is chiefly noteworthy from the hopes of its author that the slot system of picking up current is not to be despaired of. He gives the average power for a motor car of 53 passengers' capacity at 8 miles per hour average speed, as 6¾ E.H.P., the weight being 7 tons. With a trailer bringing up the passengers to 99 passengers, the E.H.P. is 8½. The current at starting may be trebled, which shows the enormous power to start and speed up as compared with horses. The present writer does not know if the London Southern Tramways Company are kept from electrical working by the action of the County Council, but he has had occasion lately to use the vehicles of this company, and finds them as slow and aggravatingly uncertain as the Chatham and Dover trains. The single line system with turnouts is folly, especially with horse traction, for it puts many extra strains on the horses. Tramway traction is simply horrible cruelty to animals. There can be little doubt that the Southern Tramways Company with a double line could run an immense traffic and half empty the trains of the Chatham and other lines, which even on fine evenings run regularly half an hour late. Prof. Elliott does not look to the steam locomotive being superseded at present, excepting upon "that well-managed line," the Metropolitan. We do not, however, endorse Mr. Elliott when he characterises the Cardiff trams as worse than any other in the country. They cannot be slower or more inadequate than the London services. London, in fact, has, to use a vulgar though expressive phrase, fallen over itself in respect to its internal communications. The waste of valuable time is intolerable. Protests to railway managers are useless, for there is no railway manager in London who is able to cope with the business, whether because the problem is insoluble, or because the ability is lacking we do not say. All classes of society suffer from lack of transportation facilities, and all experience is to the effect that given facilities the public will use them. English railway managers, with a few brilliant exceptions, invariably look on the public as an enemy to be fleeced, and are never tired of inveighing at shareholders' meetings against the public. With such a spirit it is small wonder that they take it out of the public by bad service to the loss of the

shareholders, and the loss to the public of their time. Prof. Elliott acknowledges that there are electric locomotives on the Baltimore and Ohio railroad of 1 000 H.P. each, yet he thinks it hopeful and business-like that the Metropolitan line are to spend £20,000 on experiment. We shall soon have the North-Western railroad offering a prize for anyone who can bring out a satisfactory steam locomotive, or the Lancashire spinners a prize for a satisfactory "self-actor" spinning frame. To spend comparatively small amounts on trials of new things is only reasonable caution, but no one would dream of experimenting with the use of bricks for house building or of steel for rails. Yet in matters electrical there seems to be some occult influence at work which induces an excessive caution which more than borders on the cowardice of ignorance. We think when railroad directors doubt the feasibility of electric traction they must either be very ill-informed men or badly advised. The municipal caution which sends deputations of non-technical men on Continental tours may be understood. The object is clear enough, and the rates suffer accordingly; but undertakings supposed to be conducted on commercial lines ought not to be saddled with useless experiments.

There are now working in, or under, London two buried railways with electric traction. Both these were carried out without preliminary experiment. Because the Metropolitan Railway has once been worked by steam is certainly no excuse for doubting the electrical method. We can assure the timid directorate that the electricity won't know there has been previous steam traction. Otherwise, of course, it might jib a little at the start.

PLANNING ELECTRIC LIGHT WORKS.

At the recent Cardiff meeting of the Institute of Marine Engineers, Mr. Neville Applebee had something to say on the general design of electric light works. He contrasted the high and low pressure systems especially with a view to the question of vibration in city limits, and generally as to the conveniences of coal, water, condensation, &c. Some London companies are now, he said, seeking powers to construct new works further out in order to secure advantages they could not have on a low pressure system with costly mains. Direct connection and high rotative speed meet his views best as regard engines. As regard boilers for rapid steaming, he advocates water-tube boilers; but he does not explain what he means by rapid steaming, whether getting up steam from cold water or making more steam from boilers already at full temperature. If the latter he is a trifle incorrect in his theory, and misapprehends the true conditions. But many men seem to think that when more steam is wanted from a boiler the whole boiler full of water has to become hotter. Of course, the supposition is entirely erroneous. In regard to steam pipes, he is content simply to state the fact that ring mains are usual, but he does not make any comment on them, though apparently fully aware that they require a deal of draining, and must be therefore very wasteful. Why so much money should be spent on duplicate mains is extraordinary. The risk of breakage is more than doubled, and a single well constructed steam pipe ought to be sufficient. It is not as though electrical men trusted to cast-iron pipes or to miserable brazed copper. They demand lap-welded iron or steel, or even riveted pipe, and it is really wasteful to duplicate them. For condensing plant we are rather glad to see the ejector condenser advocated as requiring no air pump. Where suitable as regards water supply, this apparatus is really far too little known. Feed pipes he again refers to as duplicate, and the direct-acting pump is condemned as a steam eater. North country practice has rather been in the direction of double ram pumps for boiler feeding of the Cameron type; but in the south, where coal is dear, the more wasteful direct pump is more used. This is especially so where there is also a ring main even to the auxiliary plant, a fact made note of by the author, but very little commented upon, as though the practice admitted of no serious question. Some duplication of plant is desirable and necessary. He is probably a wise man who effects some amount of life insurance, but if a man effects every kind of insurance which is offered to him he would have precious little margin on which to live, and it seems likely that the expenditure of so much capital on the excessive duplication of mains and other things is only multiplying the chances of breakdown at very little advantage in constant running.

This paper of Mr. Applebee's is a type of paper which has sprung into existence within comparatively recent years. They partake somewhat of the nature of platitudes. Statements are made that such and such a practice is often followed, and so on, with no comment as to the author's opinion of the method. They remind one of a criticism of Walt Whitman's poetry as consisting largely of interminable lists of things, and there is something suggestive in Whitman of the shelves of a bush store, just as there is in papers like Mr. Applebee's, of a rough stocktaking draft of an electric light station.

REVIEWS.

Gas and Petroleum Engines. By A. G. Elliott. London: Whittaker & Co. 1898. 2s. 6d.

This is a translation from the French of Henry de Graffigny, and is an attempt to afford, without mathematics, a correct idea of gas and oil engines in theory and practice. It should prove a useful little book for the young student or the business man, in helping him to a primary understanding of the subject; but it is not a general treatise, being, in fact, too small a book for this purpose. Though a few are sectional, most of the illustrations are pictorial only. The chapter on gas producers is fair, and engines are described which use producer or poor gas. This will be a very good book for the beginner and for the engineering layman.

The Theta Phi Diagram. By H. A. Golding. 1898. The Technical Publishing Company. Manchester. 3s.

This little book, one of many good manuals published by the same publishers, is an attempt to afford clear information on the subject of entropy and all that is so studiously obscured under the cognomen of two Greek letters, the better to affright the non-mathematical man, who at once shapes his course away from them.

What is entropy? This question is the one which the ordinary man fails to get answered. Our author defines *entropy* as the *co-ordinate*, with temperature, of energy; *i.e.*, it is the *length* upon a diagram whose height is absolute temperature, and whose area is heat units.

The ordinary diagram has for co-ordinates the vertical ones of pressure, the horizontal ones, distance moved, and combined—that is to say, the diagram area, they show work done. The entropy diagram, by its area, also shows work done, but in heat units. The $\theta\phi$ diagram is not drawn by the engine itself; it is plotted from the common or garden diagram, for which purpose there is taken the mean diagram of an experiment and a certain chart, and when thus plotted it shows the proportion of heat utilised to heat received, and thus enables a comparison of efficiency to be made.

The method of drawing the $\theta\phi$ diagrams is explained, and the questions of saturation and superheat are dealt with in their bearing on the diagram, and the whole is well illustrated so far as regards the number and intention of the illustrations, but very badly as regards the lettering and figuring of them, the type being far too small, the various diagrams being apparently reduced from much larger drawings by a draughtsman, who did not think to follow the proper course of making the letters and figures so large as not to become microscopic when reduced. The subject of entropy is one which presents a new mode of diagrammatic representation, and will be found confusing to those who have not previously made a study of it. But we think in this little book that students will be able to arrive at a working knowledge of the art, though the author is not always very clear, and at times is apt to assume a too ready mind in his readers.

Practical Mechanics. By Sydney H. Wells. London: Methuen & Co. 1898. 3s. 6d.

This is one of a series of elementary text-books of technology now appearing under the editorship of Profs. Garnett and Wertheimer. The present volume deals with the subject of mechanics—class room mechanics—and various experiments are illustrated and their bearing explained, the illustrations being from actual apparatus as employed at good technical institutions. It is rather a terrifying thing to be compelled to believe that the principal of every technical school in the country seems to be of opinion he must write a book on mechanics, or the special subject which he teaches, for there are already so many books on mechanics that it is difficult to know why more should be forthcoming. However, the present author has succeeded in making a book on rather novel lines, for he has introduced the subject of curves for showing the results of tests, &c., and this will undoubtedly be of great value to the student, the plotting of very elementary curves being a difficulty to so many. Needless to say, we sought the *poundal*, and lo! we found him not, though under the head of units of force there was a hint that it existed, but might be shelved from practical mechanics. We trust our author marks a departure from the common professorial herd of poundals. Professors are too apt to seize on old words and convert them to new uses, and then abuse the engineer for using wrong terms. We

saw lately an engineer's complaint about the changed meaning of the word strain. At one time it was understood to mean what is now called stress, but now it means deformation under stress, and many people consider this to be a strained definition. We ought to say a stressed definition.

We think students will find the book under review very plain. It is certainly the best small manual we have lately seen on its subject.

The Telephone: Outlines of the Development of Transmitters and Receivers. By William J. Hopkins. London: Longmans, Green & Co.

In his preface the author says that although written primarily for men engaged in practical work, it was his intention that the book should serve also as the basis for a lecture course to students. He has noted the absence of a work giving a clear and connected explanation of the principles underlying the action and the design of telephone transmitters and receivers. He has avoided making a descriptive catalogue of instruments, describing only those which have demonstrated their importance by long service or which seem to mark steps in the development of modern transmitters and receivers. The scope of the work can be very well realised by this summary of the preface. The acoustic principles and physical action are explained together with their transfer into electric energy and re-transfer into acoustic vibrations. The descriptions of instruments include the Edison carbon telephone, Hughes microphone, the Hunnings and Blake transmitters. These are followed by particulars of experiments not so generally known, which lead to the description of the "solid back," stated to have a certainty of action and a power unequalled by any other transmitter. The work will be found of interest to all who desire to acquire information on the subject; but is hardly so complete as might have been expected from the author's previous work on telephone lines and their properties.

The Telephone System of the British Post Office. By T. E. Herbert. London: Page & Pratt, Limited.

The author of this book, Mr. T. E. Herbert, is one of the Postal Telegraph engineers, and from his position is, of course, able to write with knowledge of the subject of which he treats. Moreover, as a lecturer and teacher, he would be able to appreciate the way in which to place before students, in a comprehensible manner, the various matters dealt with. The author has evidently taken considerable trouble to make the book as comprehensive and complete as possible. In the first portion the general subject of telephony is considered, early forms of instruments being described. In Chapter III., which deals with "Early Transmitters," the exact object of the "induction coil" is very definitely explained—in fact, it is the only proper description of the same we have come across. It is really astonishing how very few understand the precise object of this coil, the use of which ought, one would think, to be almost obvious. In Chapter V. good descriptions are given of "Modern Transmitters," these descriptions being sufficiently illustrated.

It is hardly necessary to go through the book in detail for the purpose of criticism; it appears to thoroughly justify its title of being a description of the telephone system of the Post Office, as all details of this system seem to be included. The writer does not (for obvious reasons) attempt any criticism of any points in the system, confining himself exclusively to description. The book is undoubtedly a very useful and creditable one, though as regards literary style and artistic illustration, there is much room for improvement; doubtless, however, as regards the latter, much has to be sacrificed in order to enable the work to be brought out at a low price. It certainly can be considered to be a very complete treatise on the subject dealt with.

The Practical Engineers' Pocket-Book, 1899. Manchester: The Technical Publishing Company.

The tenth year of publication of this very excellent little book has arrived. We are pleased to say that the pocket-book sustains its reputation as the pocket-book for the practical engineer. It has grown to over 400 pages, an addition of 28 pages having been made upon the last year's edition, variously distributed throughout the volume. Though so much larger in capacity, the thickness appears every year to be about the same, the paper being of peculiarly thin quality ganging about $\frac{1}{666}$th of an inch in thickness.

Nichelatura, Argentatura, Doratura, Ramatura Metallizzazione. Dell' Ing. J. Ghersi. Milan: Ulrico Hoepli.

Colorazione e Decorazione dei Metalli per via Chimica ed Elettrica. Dell' Ing. J. Ghersi. Milan: Ulrico Hoepli.

L'Alluminio. Dott Carlo. Formenti. Milan: Ulrico Hoepli.

These three small volumes are recent additions to Hoepli's long series of manuals of technical subjects. The first on electroplating contains a good deal of information, but its size does not admit of an exhaustive account of the subject. It is little more than a sketch. The second, on the colouring and bronzing of metals, deals with a less familiar subject, and one that is receiving a good deal of attention in some of the technical schools. This book is also very small, but contains a large number of receipts for producing different surfaces and patinas. The third volume, on aluminium, is a very short popular account of the history of the knowledge and production of the metal, and its modern production by electricity. It is not a very serious work.

A Middle Algebra. Based on the Algebra of Radhakrishnan. By William Briggs, M.A., F.C.S., F R A.S., and G. H. Bryan, Sc.D., F R S. London: W. B. Clive, University Correspondence College Press.

The Tutorial Algebra. Based on the Algebra of Radhakrishnan. Part II. Advanced course. The same authors and publishers.

These algebras are founded on the work of an Indian professor, but with considerable additions and modifications to suit the demands of English students. The first of them contains the part of algebra intermediate between the elementary and advanced stages, starting from surds and indices, and going on to series, logarithms, and permutations and combinations. The second contains a reprint of the matter of the first with twelve additional chapters on the binomial theorem, the theory of functions, series, and determinants. It is uniform in style and binding with the "Middle Algebra," and with the "Elementary Algebra" that we reviewed some months ago. The excellence of Prof. Radhakrishnan's work is attributed in the preface to an intelligent digestion of the best English authorities, particularly De Morgan, Clifford, and Chrystal; and the editors consider that his treatment of the subject provides a foundation for a better text-book of the subject for their particular purpose than has been produced by any English mathematician. Certainly the explanations and treatment are very clear, and the usual paradoxes and difficulties are extremely well treated. The manipulation of ratios tending to zero or infinite values, the interpretation of negative and fractional indices, the solutions of problems in maxima and minima, and the discussion of equations leading to solutions inapplicable to the problems to be solved, at which we looked as being standing difficulties for students, seem to us thoroughly well done. Both books contain a large amount of matter for their size, the problems being very numerous, and are well got up. They are excellent numbers of a very useful series of educational works.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1898.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

25,592. "An improved fusible cut-out for electric circuits." F. W. Heaton and H. Smith. Dated December 5th.

25,632. "Improvements in electric arc lamps." J. S. Blackwell and W. A. Charles. Dated December 5th.

25 657. "Improved electrical signalling devices for railways." L. Jacob. Dated December 5th.

25,667. "Improvements in electrical resistance coils." S. W. Cuttriss. Dated December 6th.

25,670. "Improvements in electrical induction apparatus." T. C. Kinraide. Dated December 6th. (*Complete.*)

25,710. "Improvements in dynamos." J. E. Fuller. Dated December 6th. (*Complete.*)

25,734. "Improvements in secondary batteries." W. Schlothauer and A. E. Preece. Dated December 6th.

25,746. "Improved means for electrically heating ovens, hot chambers, rooms, and the like." F. Christy and L. F. Christy. Dated December 6th.

25,747. "Improvements in or connected with incandescent electric lamps." J. W. Swan. Dated December 6th.

25,764. "Improvements in devices for making and breaking surface contact on electrical tramways." W. F. Stamp. Dated December 6th.

25,863. "Improvements in and in connection with radiating axles for electrically propelled railway or tramway cars." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated December 7th. (*Complete.*)

25,877. "Improvements in or relating to contact devices for electric igniters of explosion engines." A. J. Boult. (Société Nouvelle des Etablissements Decauville Aine, France.) Dated December 7th.

25,895. "Improvements in and relating to electric switch or key lampholders or sockets." P. G. Ebbuit and Veritys, Limited. Dated December 8th.

25,896. "Improvements in connection with electric lampholders or sockets." P. G. Ebbutt and Veritys, Limited. Dated December 8th.

25,955. "Improved dynamometer or weighing machine." W. P. Thompson. (H. S. Elworthy, Russia.) Dated December 8th.

25,961. "Improvements in insulator brackets for electric conductors." C. Pellenz. Dated December 8th.

26,014. "Improved electric stop motion for drawing frames." J. McQueen and D. Barker. Dated December 9th.

26,020. "Improvements in and relating to electrical switches." H. W. Cox. Dated December 9th.

26,026. "Improvements in and relating to electric batteries." W. G. Heys. (S. Silberberg, United States.) Dated December 9th. (*Complete.*)

26,033. "Improvements in connectors for electrical cables or wires." H. W. Miller, W. Turvey, and G. C. Weston. Dated December 9th.

26,038. "New or improved means for electrically operating clocks." W. B. Buer, T. W. Legge and J. Tabrar. Dated December 9th.

26,067. "A new or improved holder for electric glow lamps." H. C. Gover and C. F. Proctor. Dated December 9th. (*Complete.*)

26,068. "Improvements in electrical glow lamp fittings." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated December 9th. (*Complete.*)

26,073. "Improvements in or connected with the arrangement of conductors for transmitting electrical energy from a generating station upon land to a movable structure in water." A. F. Hills. Dated December 9th.

26,074. "Improvements in or connected with electric motors." A. F. Hills. Dated December 9th.

26,092. "An improved mode of winding for the armatures of dynamos and electric motors." A. C. G. Cumming. Dated December 10th.

26,116. "Improvements in and relating to galvanic batteries." W. G. Heys. (S. Silberberg, United States.) Dated December 10th. (*Complete.*)

26,136. "An improved electrical measuring instrument." K. Lehner. Dated December 10th. (*Complete.*)

26,145. "Improvements in continuous current dynamos, motors, and motor dynamos." A. O. Berry. Dated December 10th.

26,153. "Improvements in and in connection with telephonic microphone apparatus for electric signalling." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated December 10th. (*Complete.*)

26,164. "A resistance switch for electric motors." C. B. Callow and J. Eck. Dated December 10th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free,* 9*d.* (*in stamps*).

1897.

9,442. "Improvements in pressing electric accumulator plates and other plastic articles." R. R. von Berks and J. Renger. Dated April 13th, 1897. Relates to apparatus for moulding electric accumulator plates and other plastic articles. The mould is built up of a number of interchangeable sections held in a plate by wedges; it is covered by a plate secured to the bedding plate by screws or otherwise. The plastic material supplied through the pouring hole is forced by a piston through the openings between the mould sections. To ensure that the material may pass through all the openings at the same speed, the larger openings are contracted outwardly and the smaller openings expanded. 2 claims.

9,456. "Improvements in secondary batteries." J. H. McLean and C. D. Burnet. Dated April 13th, 1897. The negative plate consists of a sheet of lead having through it a number of holes, each with a funnel-shaped mouth, at one end the mouths of adjacent tubes being situated on opposite sides of the plate. The positive plate consists of a thick sheet of lead with holes on each side, which do not pass completely through the plate, and the said holes may alternate with each other, or be co-axial. 3 claims.

12,957. "Improvements in transforming alternating into continuous electric currents or *vice versâ*." A. Muller and H. Tudor. Dated May 25th, 1897. Relates to means for converting alternating into direct currents, and *vice versâ*, for charging secondary batteries, &c. In converting an alternating current from a generator, a commutator is driven synchronously by a motor, and to prevent sparking at the contacts a polarisation battery is switched in for the period when the tension of the current is below that of the secondary battery. The commutator carries a number of contacts connected with rings on which the brushes rub connected with the battery. Between these contacts connected with the polarisation battery, the brushes are connected to the generator. The apparatus may be used for converting continuous into alternating currents by supplying a continuous current from a battery or other source, and rotating the commutator by a suitable motor. Similarly, it is stated, polyphase current may be converted, and *vice versâ*. 1 claim.

1898.

9,340. "Improvements in electric safety fuses or cut-outs." Veritys, Limited, and L. J. Stale. Dated April 22nd, 1898. This invention provides a method of preventing an electric arc, while dispensing with the necessity of immersing the terminals under oil. This is done by means of a fuse fixed to the terminals and mounted on an insulating frame or the switchboard itself. The fuse wire is passed through a vessel containing oil or, in some cases, only air. When the wire fuses this vessel moves by the action of gravity, and in so doing causes the loose end of the fuse to be drawn into the vessel or under the surface of the oil, and the arc is thus quickly interrupted, the motion of the fuse being twice the rate at which the vessel moves. 6 claims.

10,437. "Improvements relating to cut-outs and switches for electric motors and other electrical apparatus." A communication from H. H. Cutler. Dated May 6th, 1898. The main object of this invention is to provide an automatic cut-out combined with a device for introducing a time element into its operation, so that the circuit will be opened or interrupted only after the flow of an abnormal current for a predetermined period of time. 12 claims.

13,308. "An electro-thermic incubator." A. E. Greville. Dated June 14th, 1898. This relates to a means of supplying heated moist air to an incubator, and consists of a superposed water tray, upon the under side of which an electrical resistance coil is provided, so that heat is radiated and water evaporated while the circulation of air is permitted. 4 claims.

13,735. "Improvements in primary batteries." W. Rowbotham. Dated June 3rd, 1898. Relates to batteries of the kind described in specification No. 2,378, A.D. 1897, in which the separate cells are arranged in steps and the liquids circulate through them from the uppermost to the lowest. The positive electrode may be iron and the liquid in contact with it is water, and the cock of the water cistern is connected with a switch in such a manner that when the switch is operated to break the battery circuit the cock is opened and a stream of water flows through the battery so as to prevent local action on open circuit. 1 claim.

13,895. "Method of reducing the energy of magnetisation of electrical transformers when the output is small." Siemens Bros. and Co., Limited. Dated June 22nd, 1898. This invention is for effecting the reduction of the energy of magnetisation in polyphase current, by connecting the primary and secondary circuits respectively by means of mesh form connections when the load is considerable and by means of star form connections when the load is small. 1 claim.

15,976. "Improvements in electric arc lamps." W. C. Johnson and A. Winderlich. Dated July 21st, 1898. This relates to an arrangement of regulating the mechanism of an electric arc lamp. The upper carbon is held in a split tube, which is free to move within an enclosing tube. This enclosing tube is at its lower end somewhat loosely attached to a piston, in which is formed a conical seating for several rings arranged in slots in the boss of the piston. The upper end of the tube is attached to a pair of chains, which pass over pulleys and are attached to the cores of two solenoids, these cores being connected together by a cross bead, through the middle of which the tube passes. In attaching the chains to the cores springs are interposed so as to avoid vibration of the feeding mechanism. From the base of the lamp frame a tube projects upwards to form a stop for the rings. 1 claim.

17,821. "Improvements in or connected with secondary batteries." F. King. Dated September 24th, 1895. Relates to a secondary battery element plate, having a number of perforations extending through the grid and finished plate. The perforations may have conical or parallel sides, and in the finished plate are unoccupied by active material or material to be rendered active. 2 claims.